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N8120R:72-027

ENGINEERING OPERATIONS REPORT

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NERVA 400E THRUST TRAIN

DYNAMIC ANALYSIS

PROJECT 110

14 APRIL 1972

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CLASSIFICATION CATEGORY
Unclassified
U A Pineda 4/13/72
CLASSIFYING OFFICER DATE

192

D. F. Vronay
14 April 1972

N8120R:72-027

SUMMARY

The natural frequencies and dynamic responses of the NERVA 400E engine thrust train were determined for Nuclear Space Operations (NSO), and Earth-Orbital Shuttle (EOS) during launch and boost conditions. For NSO, a "mini-tank" configuration was analyzed with the forward end of the upper truss assumed fixed at the stage/mini-tank interface. For EOS, both a mini-tank and an "engine only" configuration were analyzed for a specific Engine Assembly Support (EAS) stiffness. For all cases the effect of the shield on dynamic response characteristics was determined by performing parallel analyses with and without the shield. Gimbaling loads were not generated as that effort was scheduled after the termination date.

The analysis, while demonstrating the adequacy of the engine design, revealed serious deficiencies in the EAS. Responses at the unsupported ends of the engine are excessive. Responses at the nuclear subsystem interface appear acceptable. It is recommended that additional analysis and design effort be expended upon the EAS to ensure that all engine responses stay within reasonable bounds. In particular, the inclusion of damping in the EAS should be given careful consideration in all future designs. Supports at the ends of the engine appear necessary during launch.

NERVA 400E THRUST TRAIN
DYNAMIC ANALYSIS

I. INTRODUCTION

The purpose of this analysis was to determine the natural frequencies and dynamic responses and loads of the NERVA 400E thrust train for Earth Orbital Shuttle (EOS) and Nuclear Space Operation (NSO). The following six "cases" were analyzed. For EOS, both a mini-tank and an "engine only" configuration were analyzed for a specific Engine Assembly Support (EAS) stiffness. For NSO, only the mini-tank configuration's response was investigated. For both EOS and NSO parallel analyses were performed with and without the shield to determine its effect on the thrust train loads. Table 1 and Figures 1, 2, and 3 show, conceptually, these six cases and their identification. Figure 4 shows the major engine interfaces and corresponding grid points and engine stations.

For each of the six cases the natural frequencies and mode shapes were determined. A subset of these normal modes were then used as the degrees of freedom to describe the engine characteristics for the dynamic response calculations. For EOS the system input consisted of the data of Reference 1. For NSO the input was the same as that for NSO in Reference 2. In each case a frequency response analysis was run and loads determined. Table 2 is a summary of the natural frequencies for all cases. Tables 3, 4, and 5 summarize interface displacement and acceleration responses, while Tables 6, 7, and 8 summarize the interface loads, for EOS engine only, EOS mini-tank, and NSO respectively. In Tables 6, 7, and 8 the key to the column headings is as follows:

BM-1:	Bending Moment in the X-Y Plane
BM-2:	" " " " X-Z "
S-1:	Shear in the X-Y Plane
S-2:	" " " X-Z "
Axial:	Axial Load
Torque:	Torsional Bending Moment

The engine coordinate system is defined in Reference 3, and is shown in Figure 5. The actuator loads are summarized in Table 9.

Section II presents the details of the analysis for EOS and NSO.

Section III contains a list of references, including the drawings from which the engine was modeled, and the tables and figures referenced in this report.

Appendix A is a listing of the basic BULK DATA decks for each of the six cases of Table 1. Appendix B is a list of the multi-point constraint (MPC) equations used to model the mini-tank.

II. TECHNICAL DISCUSSION

The structural dynamic analysis of the NERVA 400E engine thrust train was accomplished using the NASTRAN computer program and the all new three dimensional model, as promised in Reference 2. The basic engine model consisted of 456 unconstrained degrees of freedom and was an assembly of metric and scalar finite elements. All structural mass was "lumped" at the grid points as translational inertia only. The inertia of any nonstructural mass items however was accurately accounted for by the inclusion of all significant terms of the item's mass matrix. Table 10 is a listing and identification of the degrees of freedom of the basic engine model.

The mini-tank, when required, was incorporated into the basic engine model using a modal synthesis technique per Reference 4. Since all cargo bay interface points were assumed to be in phase, and since the truss/mini-tank interface portion of the tank was reinforced, adequate representation of the mini-tank was achieved using the three translational rigid body modes plus the six lowest free-free elastic modes for the first (m = 1) harmonic. The fiberglass truss members connecting the mini-tank to the stage and Upper Thrust Structure (UTS) were assumed to carry axial loads only. The mini-tank was assumed empty for all analyses. Figure 6 shows the geometry and nodal breakdown used to determine the mini-tank modes. Table 11 is a list of the generalized mass and stiffness values used for the mini-tank synthesis and the natural frequencies of its elastic modes. Appendix B is a listing of the multi-point constraint (MPC) equations used to model the mini-tank.

The Engine Assembly Support system (EAS) was modeled as a combination of scalar springs so chosen as to keep the EAS natural frequencies above the highest EOS input frequency. These "springs" were connected between the engine attach

points and the shuttle cargo bay floor (see Figure 4). Table 12 is a list of these spring stiffnesses. No damping was included in the EAS design and it is believed that this contributed appreciably to the very high responses shown for the "engine only" cases (Cases 1 & 2). It is recommended that all future engine analyses include the EAS as part of the engine design, and that some type of external damping be incorporated in the initial analyses.

The Nuclear Subsystem (NSS) was modeled as the scalar system shown on Figure 7. It was intended to replace this simplified NSS with a modal model for the final analyses, but termination of the program precluded achieving this goal even though the required data were available.

Sections A and B present the detailed results for EOS and NSO respectively. Section III contains a list of references. Listings of the basic BULK DATA deck for each of the three major configurations (EOS engine only, EOS mini-tank, NSO) appear in Appendix A.

A. PRESENTATION OF RESULTS FOR EOS

This section presents the results of the dynamic analysis of the NERVA 400E engine thrust train for EOS launch and boost. Two major configurations were analyzed: "engine only" (Cases 1 & 2) and engine with mini-tank (Cases 5 & 6). Odd numbered cases (1 & 5) refer to configurations with the shield and even numbered cases (2 & 6) to an engine without the shield. The same EAS was used for both analyses, although the mini-tank has the effect of an additional restraint on the engine as it was assumed fixed at the forward end of the cargo bay. However, all cargo bay interfaces were considered as "driven" points for purposes of analysis. At this point of the analysis no attention had been given to the need, if any, for a separate mini-tank support.

The loading was that of Reference 1. There were no engine natural frequencies below 20 Hz, so only the 10-35 Hz range was of interest. As no detailed spectral breakdown was available it was impossible to run a transient forcing function exhibiting the desired harmonic decay indicated in Reference 1. Instead, a frequency response analysis was run using the maximum loads, encountered at Cut-Off/Separation, i.e., 1.5g longitudinal (X) and 1.0g lateral (Y&Z), over

the 10 to 35 Hz range. The interpretation of the results of such an analysis is always open to speculation; i.e., just what do they mean, and how are they to be used to realistically evaluate the design. For example, Table 13 shows a typical acceleration response over the frequency range of interest. If the response at each frequency is merely summed, this assumes that the full power of the input is available at each and every frequency of the spectrum simultaneously and in phase. Such an assumption, while usually providing a conservative upper bound to the response, is hardly realistic. A more frequently used method of data reduction is a type of weighted average of the results whereby the response at each frequency is squared, then summed, and finally the square root taken of this sum. This root-sum-square method (RSS) has some usefulness if nothing is known of the system response characteristics, as it will, normally, yield conservative results. However, in the case of the NERVA 400E engine thrust train, as in most elastic structures, the response is typically of a "narrow band" type, i.e., most of the response occurs in a narrow band centered about each natural frequency of the system. The RSS method can then be applied to the responses in each of these bands to obtain the total response. Such an approach still assumes that the full power of the input is available at each natural frequency and that all normal modes of the system respond in phase, both conservative assumptions. However, lacking a more detailed spectral breakdown of the input excitation, it is believed to be the most realistic method of interpreting the results of this type of analysis for this particular structure. Therefore, all data presented for EOS are rms values assuming a narrow band response with the full input power being available and in phase at each natural frequency of the system. Table 13 shows the results of the three types of data reduction for the typical acceleration response shown.

Tables 14, 15, 16, and 17 list and identify all natural frequencies up to twice the highest input frequency for Cases 1, 2, 5, and 6 respectively. Figures 8, 9, 10, and 11 show the corresponding normal mode shapes. Tables 3, 4, 6, and 7 are summary tables of the rms displacement and acceleration responses and thrust train loads for these same cases. It is important to note that while removal of the shield predictably raises the engine natural frequencies, its effect on the responses and loads is not uniform throughout the thrust train.

B. PRESENTATION OF RESULTS FOR NSO

This section presents the results of the dynamic analysis of the NERVA 400E engine thrust train for NSO. The mini-tank configuration was analyzed both with and without the shield as Cases 7 and 8 respectively. The upper truss was assumed fixed at the stage for the analysis, the truss/mini-tank/truss/engine assemblage forming essentially a cantilevered beam. The input consisted of the random accelerations characterized by the Power Spectral Density curves shown in Figures 12 and 13 for the TPA and Nozzle, respectively. All loads were applied simultaneously along each of the three coordinate axes over the 0-100 Hz range. All responses are 3σ values.

Tables 18 and 19 list and identify the engine natural frequencies below 100 Hz for NSO, and Figures 14 and 15 are the fourteen lowest mode shapes for Cases 7 and 8 respectively. Tables 5 and 8 are the displacements and accelerations, and interface loads, for these same cases.

III. REFERENCES

1. Memo, NASA S&E-ASTM-AA(71-46), "Acceleration Loads for Earth Orbital Shuttle (EOS) Launch", July 30, 1971

2. ANSC Memo N8120:053, To W. E. Stephens from U. A. Pineda, Subject: "Transmittal of Report N8120R:71-003, 'Launch and Nuclear Space Operation Vibration', Project 110", dated 7 July 1971

3. ANSC Memo N8610:011M, To K. Sato from A. D. Cornell, Subject: "Engine Coordinate System", dated 2 June 1971

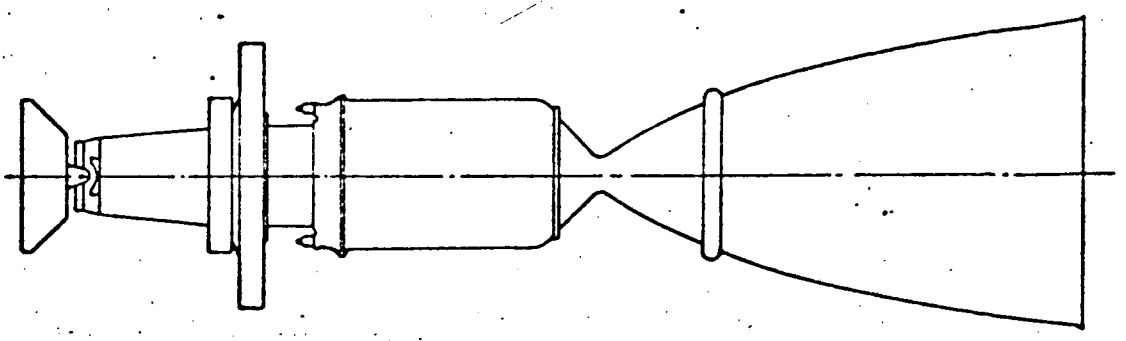
4. NASA SP-221, "The NASTRAN Theoretical Manual", September 1970

5. The following Aerojet drawings were used:

1137400E	Engine Layout
1138808A	Pressure Vessel and Closure
1138000A	Nozzle
1137992C	Nozzle Extension
1138420D	Gimbal Assembly

1137978B	Gimbal Pivot
1137985	UTS
1138641	LTS
1138352C	External Shield

FIGURE 9-1



f = 24.062 Hz

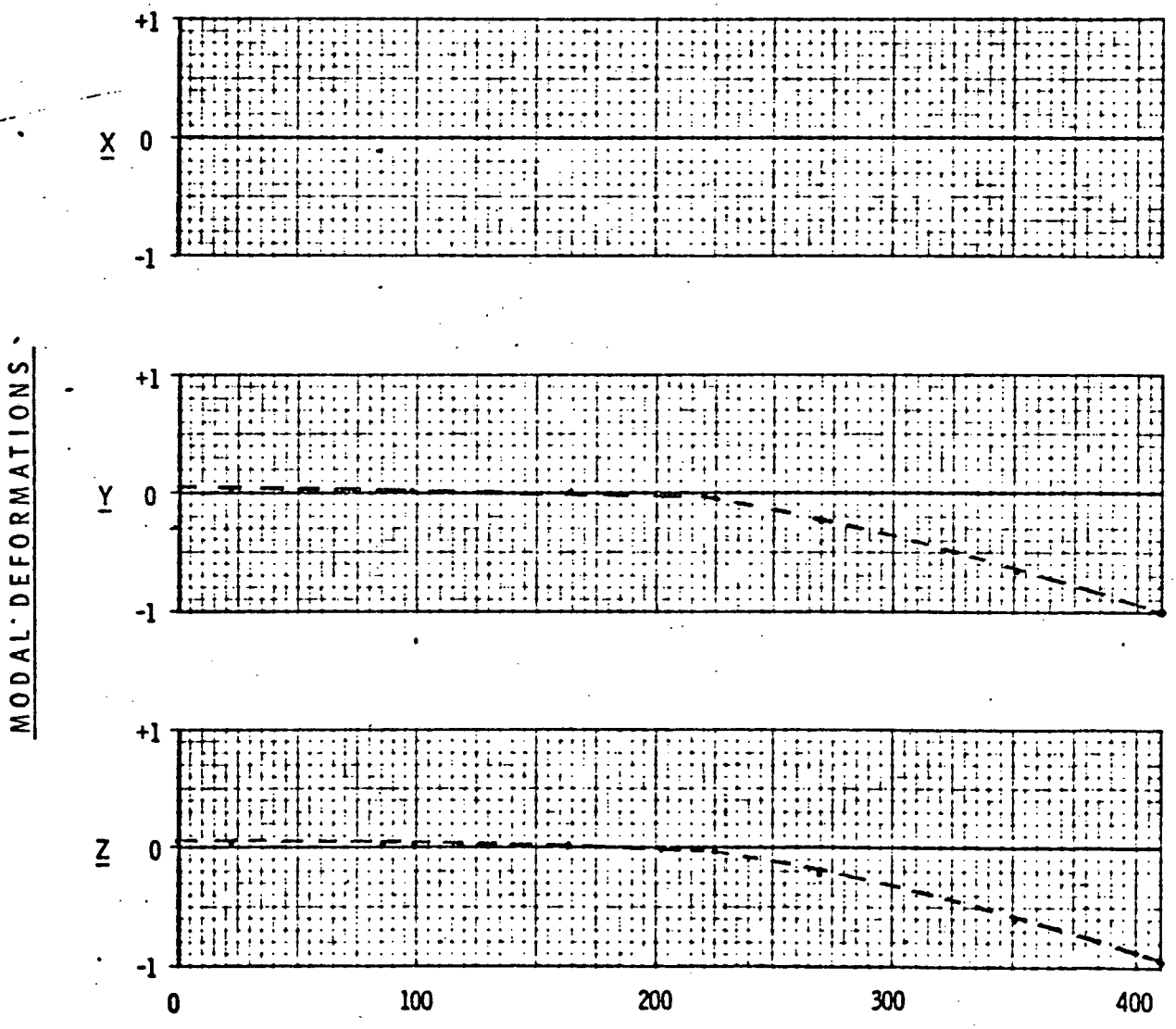
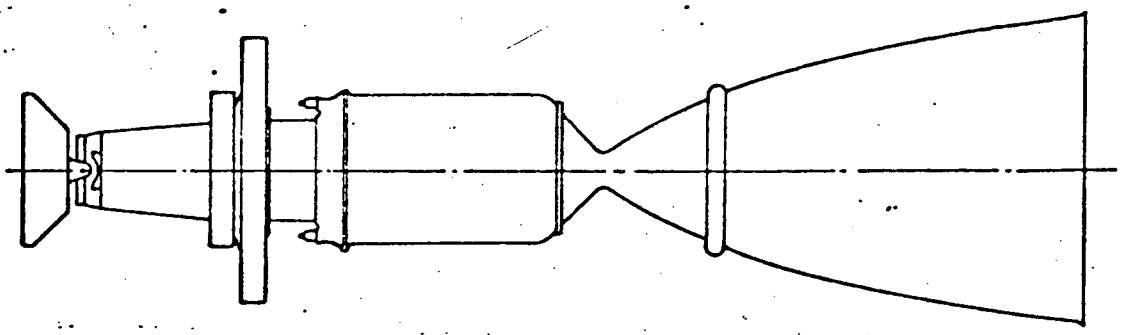


FIGURE 9-2



f = 24.121 Hz

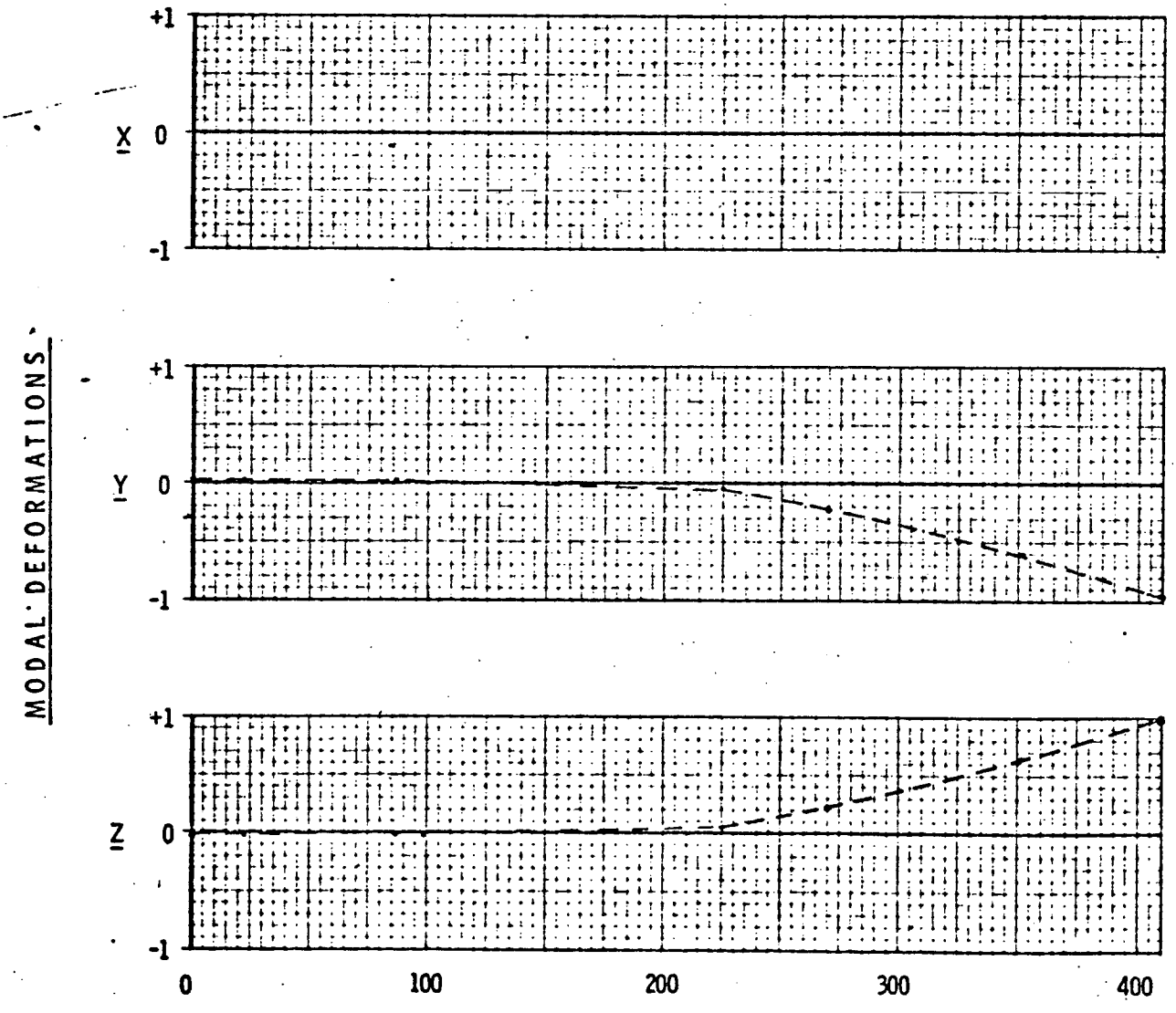
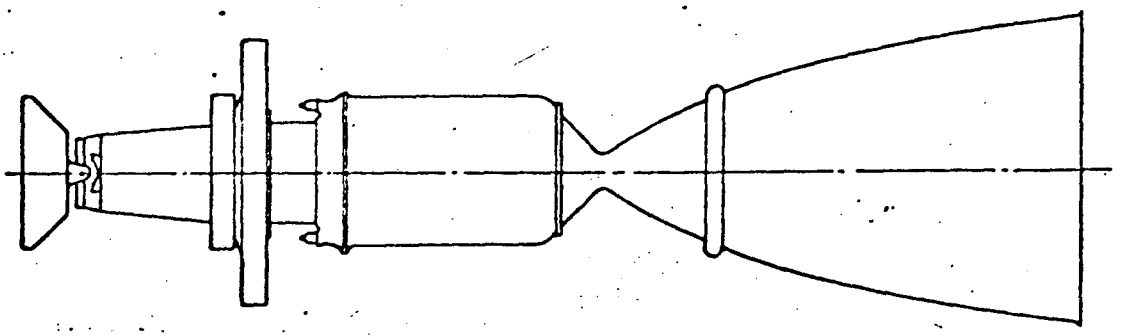


FIGURE 9-3



f = 35.409 Hz

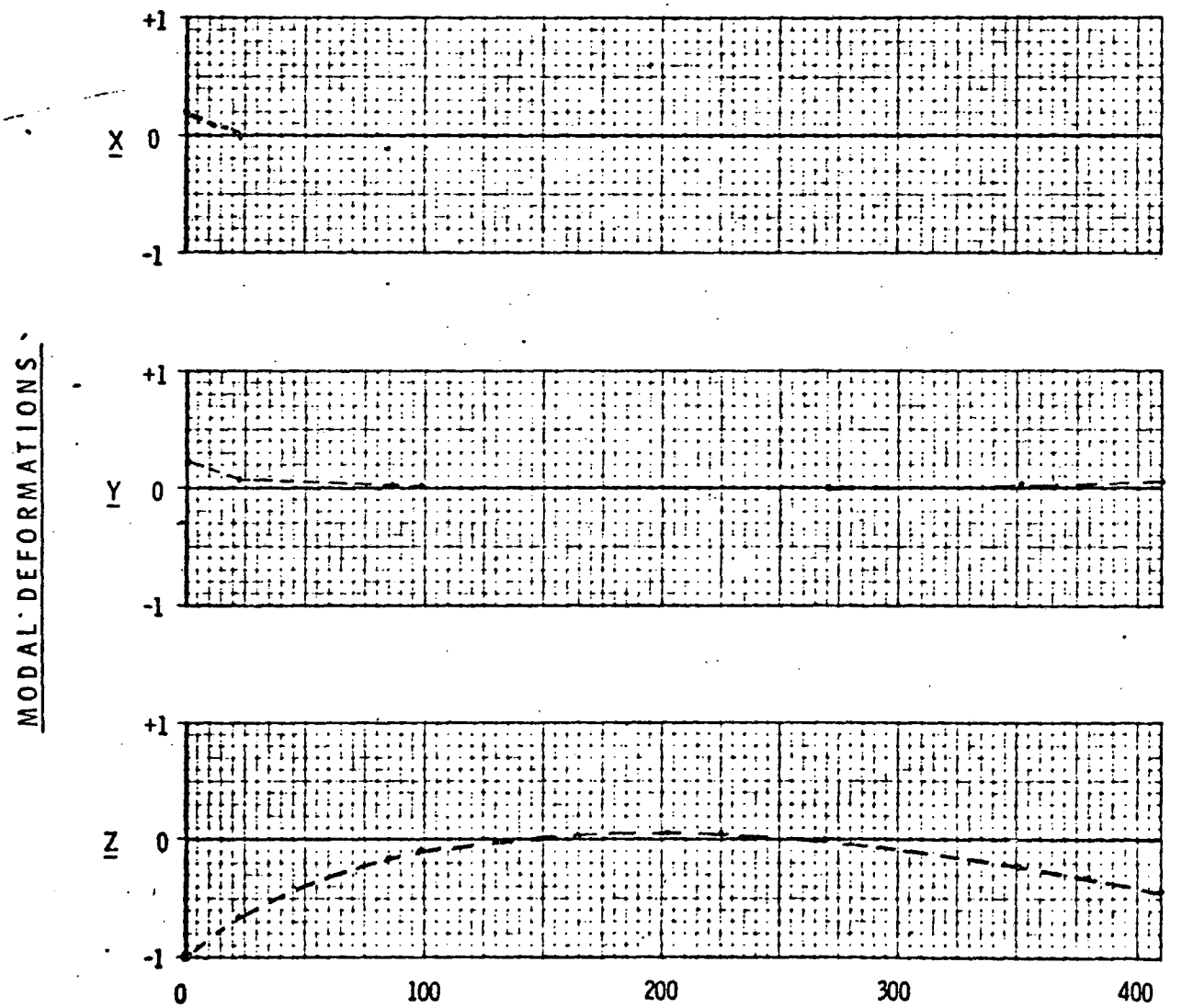
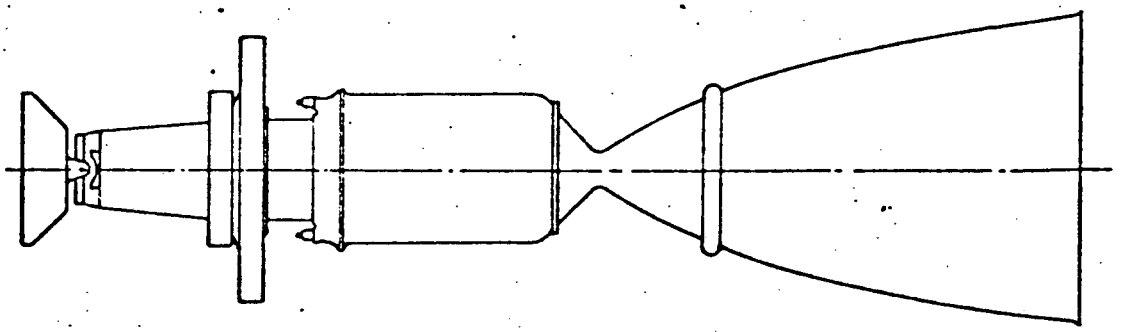


FIGURE 9-4



f = 35.74 Hz

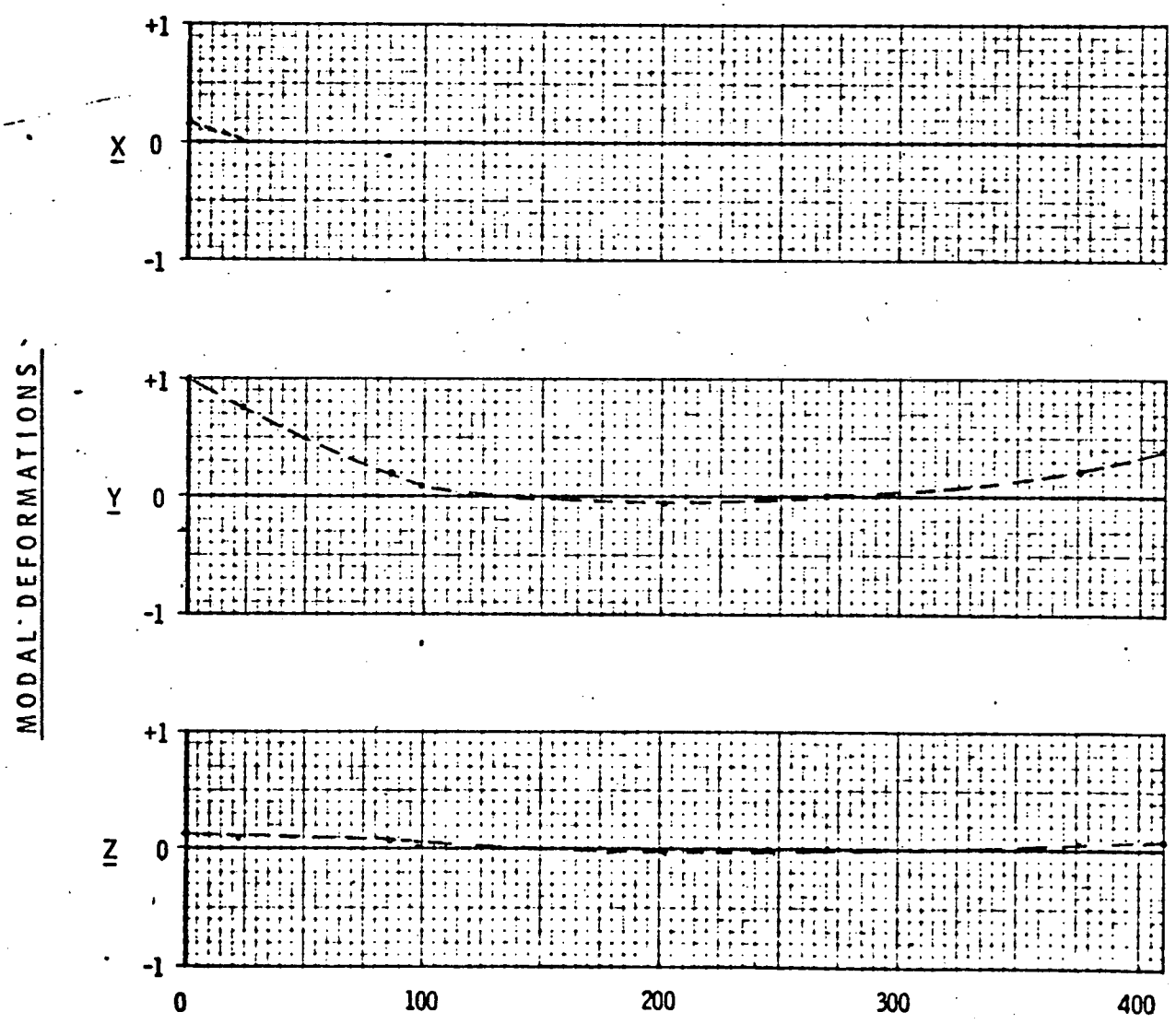
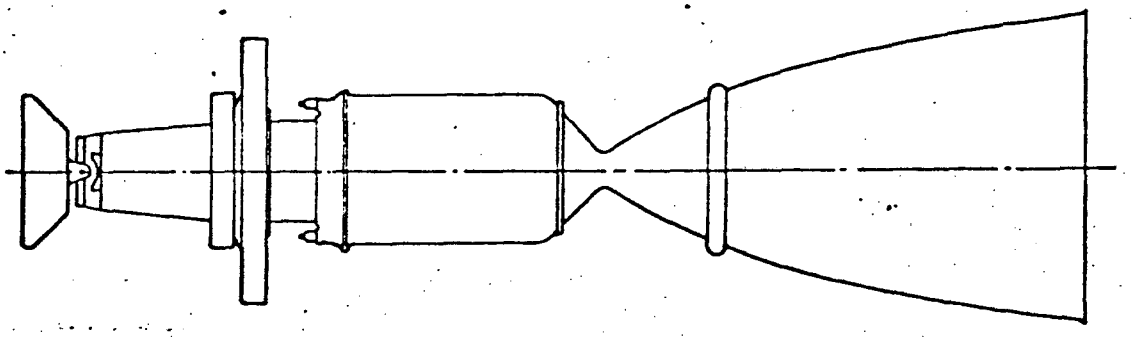


FIGURE 9-5



f = 40.74 Hz

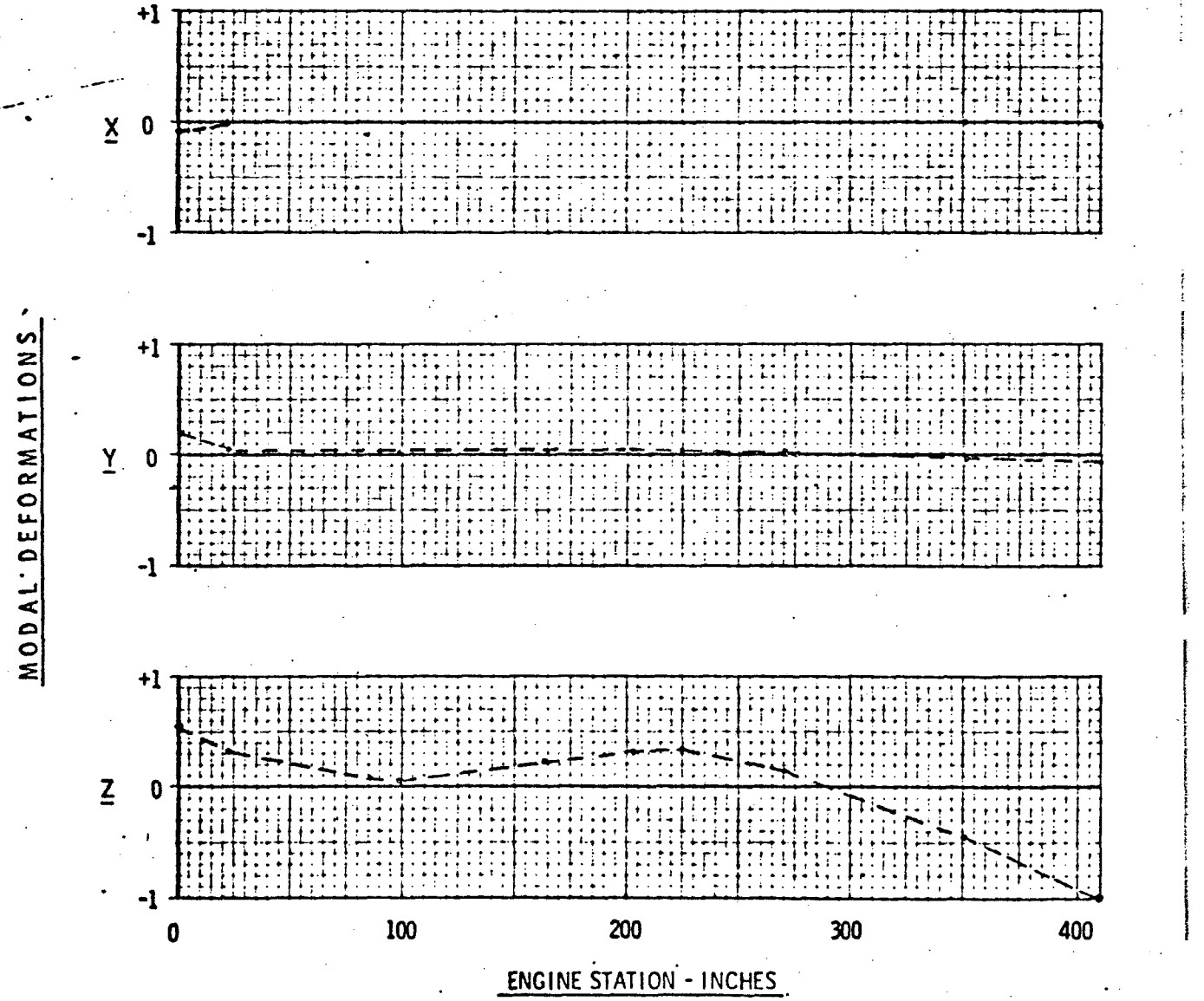
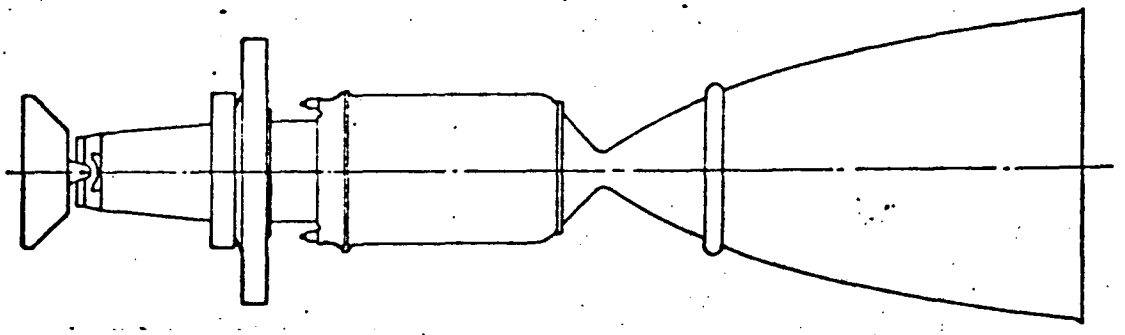


FIGURE 9-6



f = 41.13 Hz

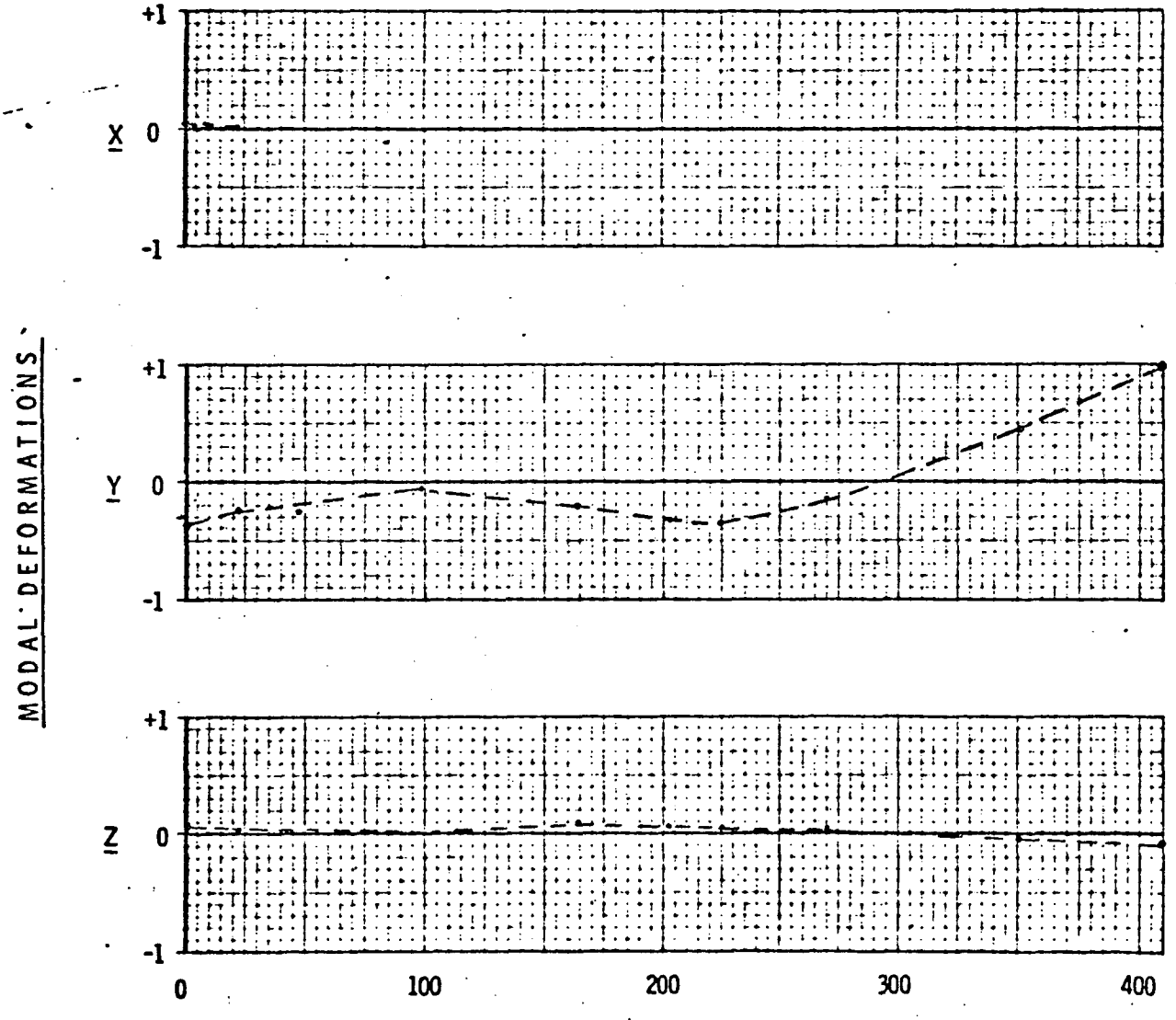
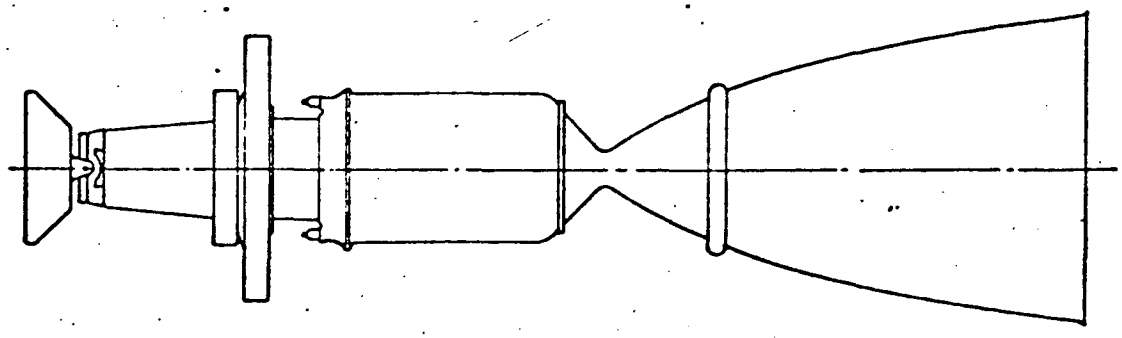


FIGURE 9-7



f = 46.23 Hz

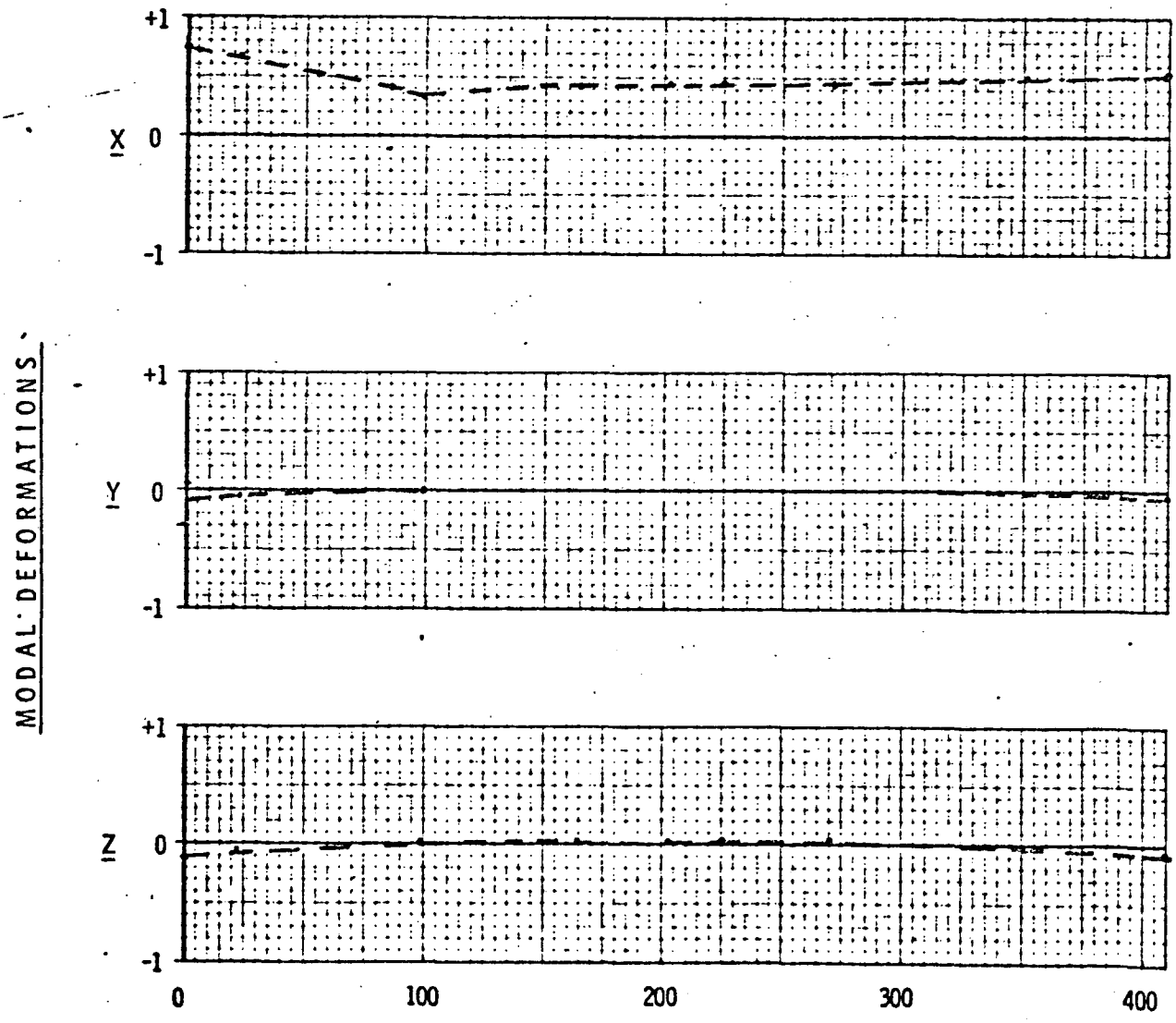
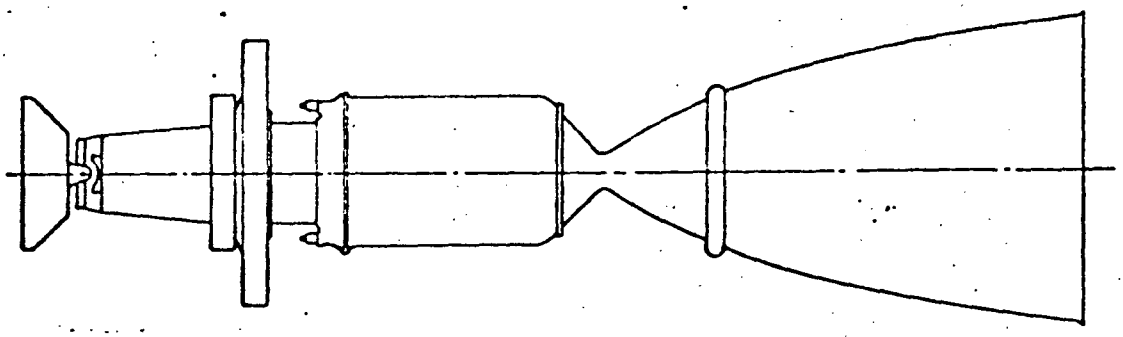
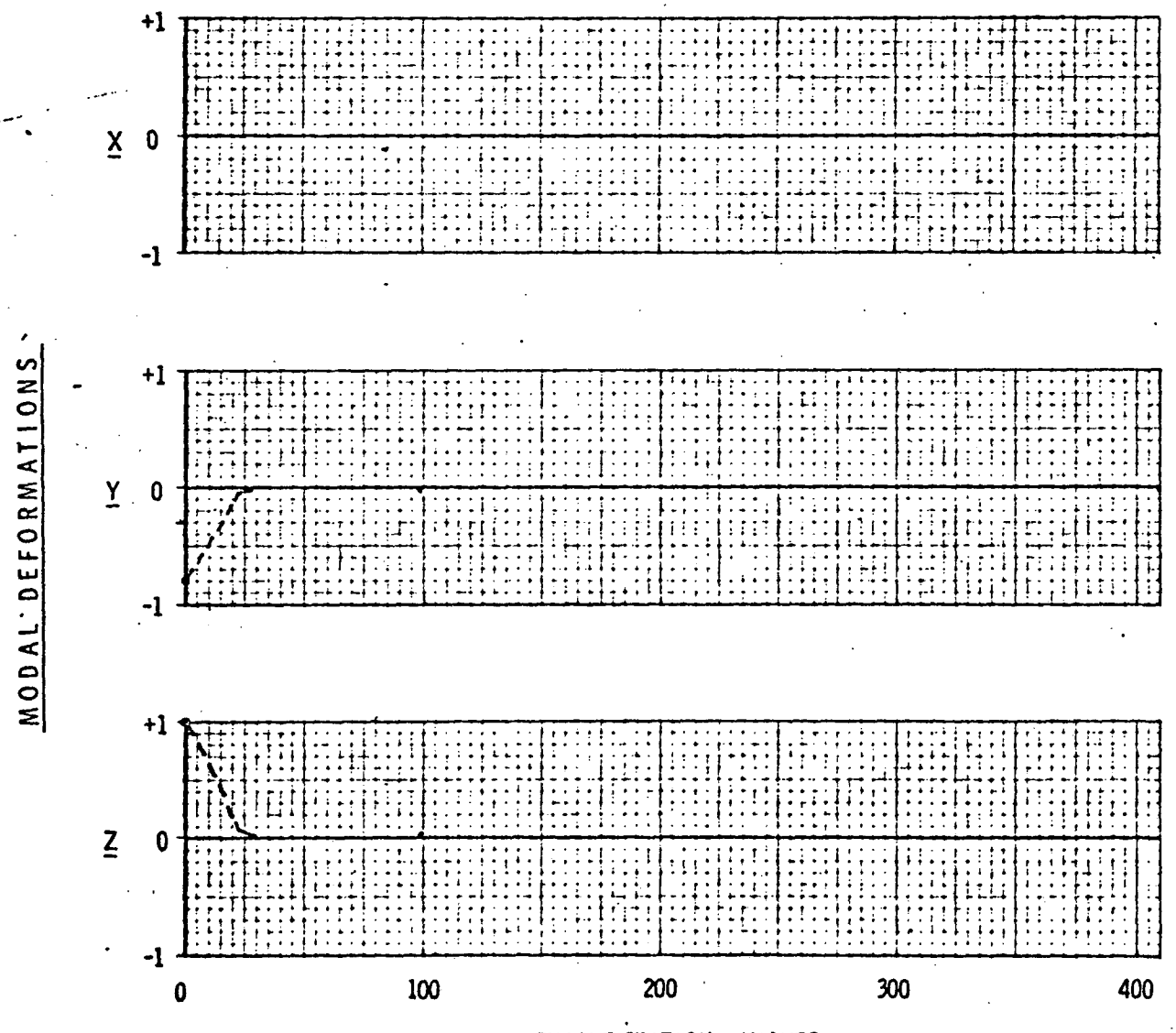


FIGURE 9-8



f = 49.96 Hz



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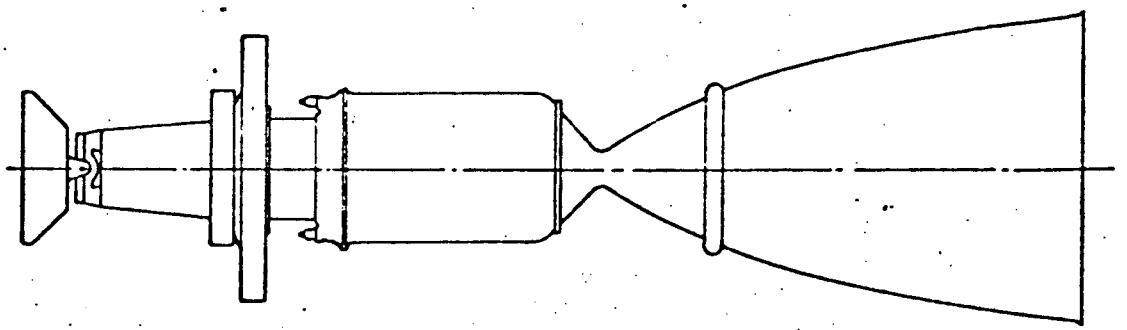


f = 62.90 Hz

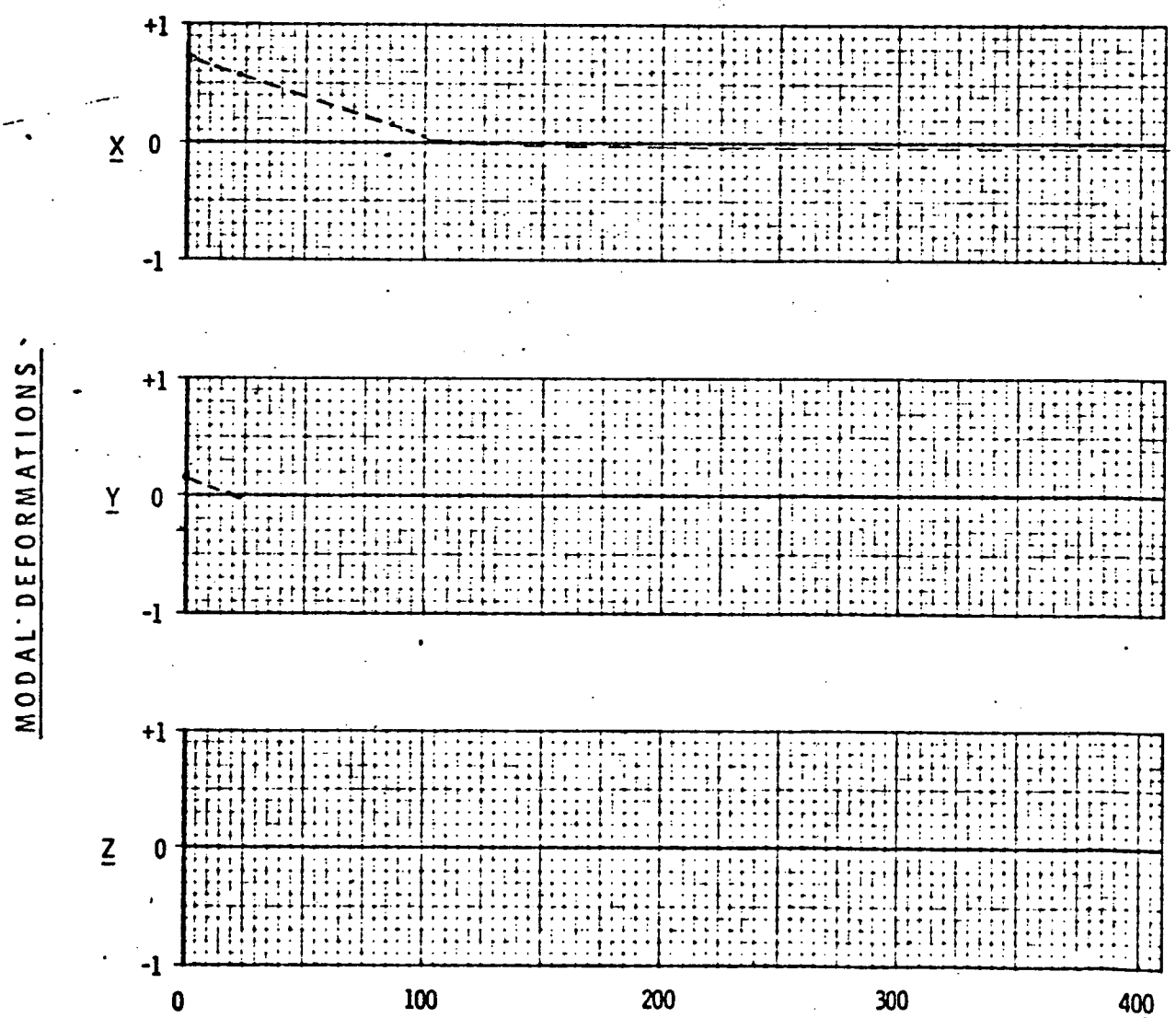
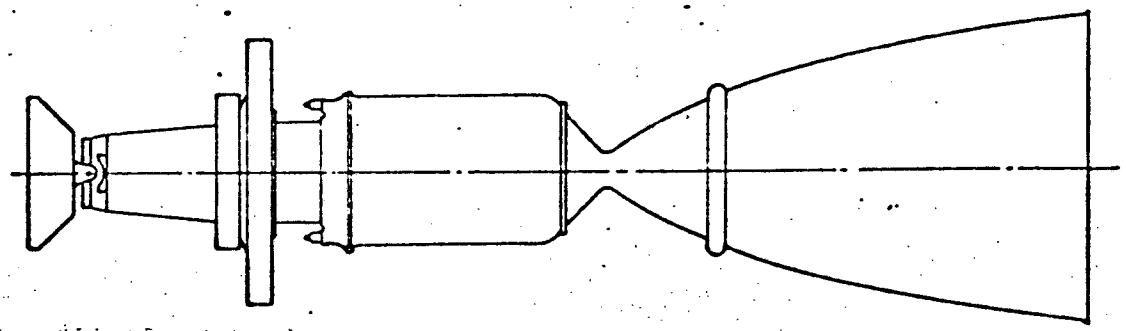


FIGURE 9-10



f = 72.48 Hz

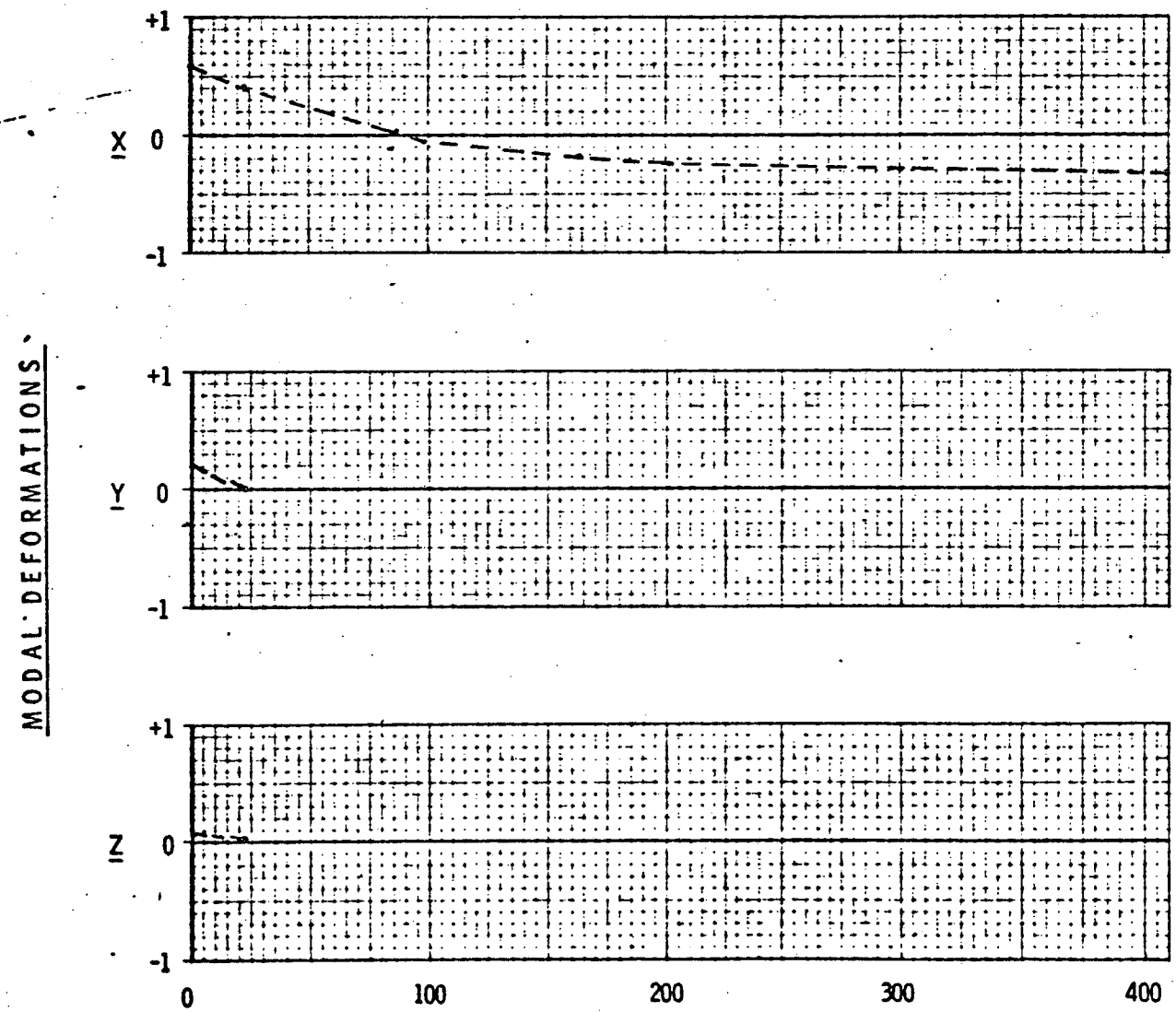
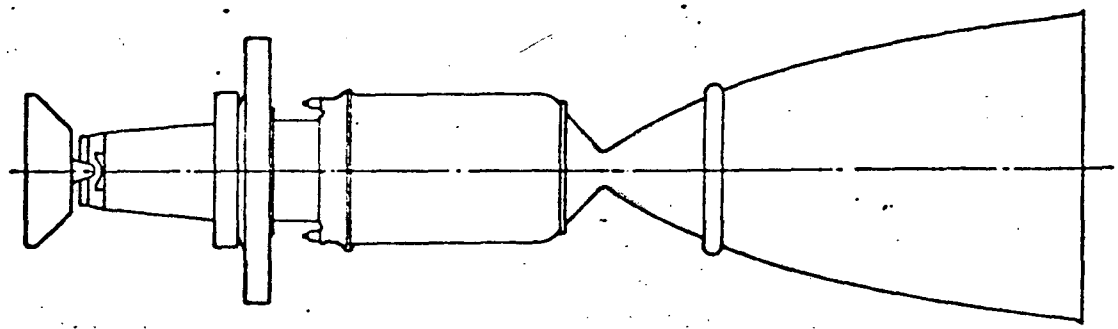
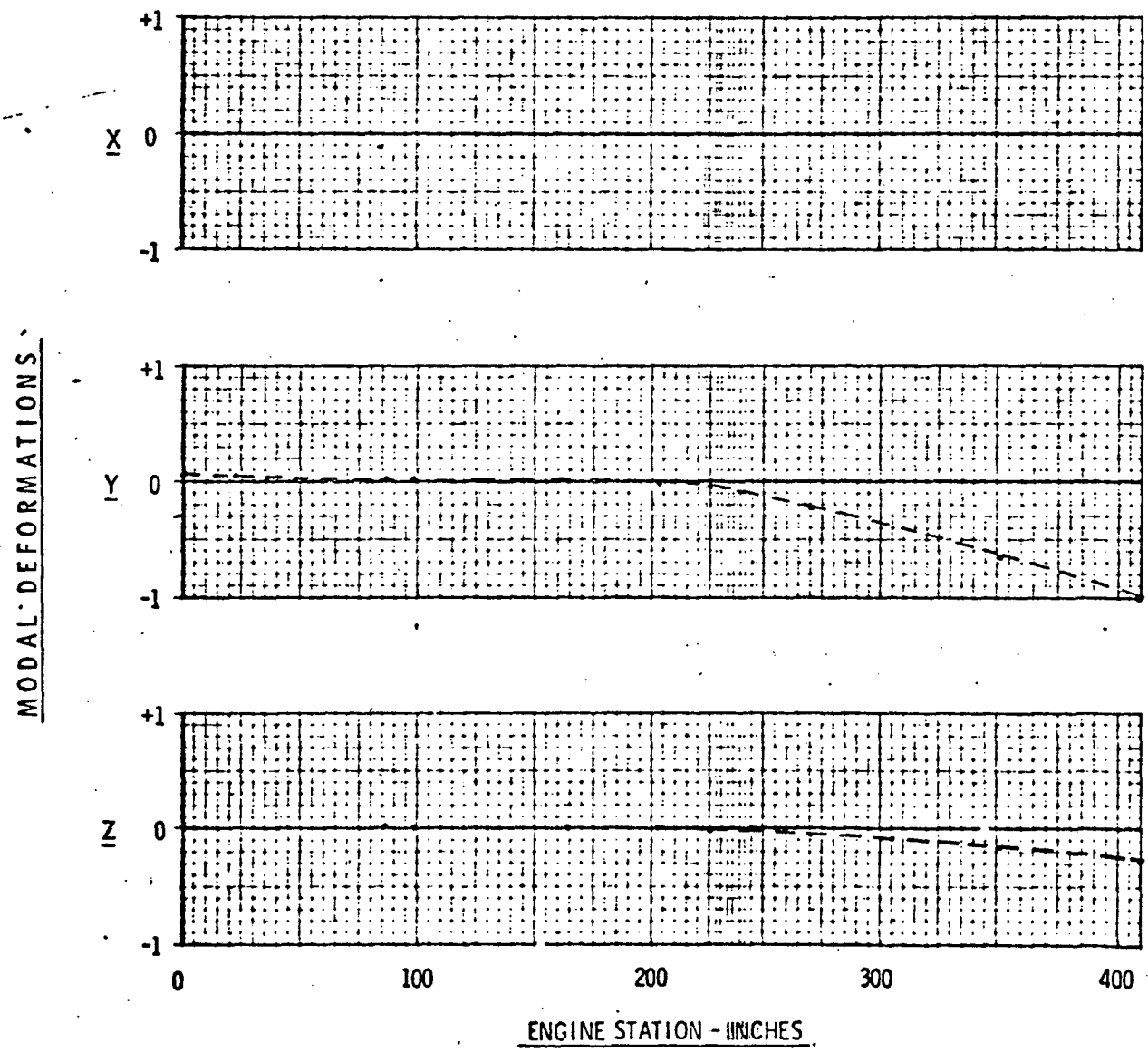


FIGURE 10-1



f = 23.944 Hz



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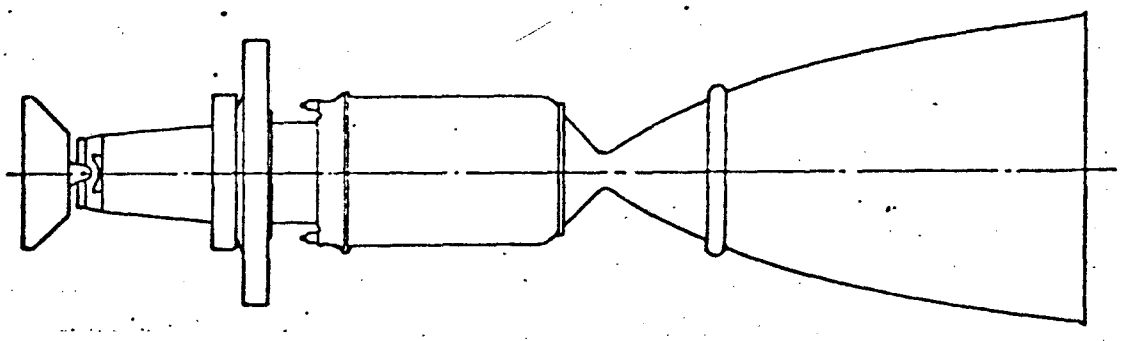
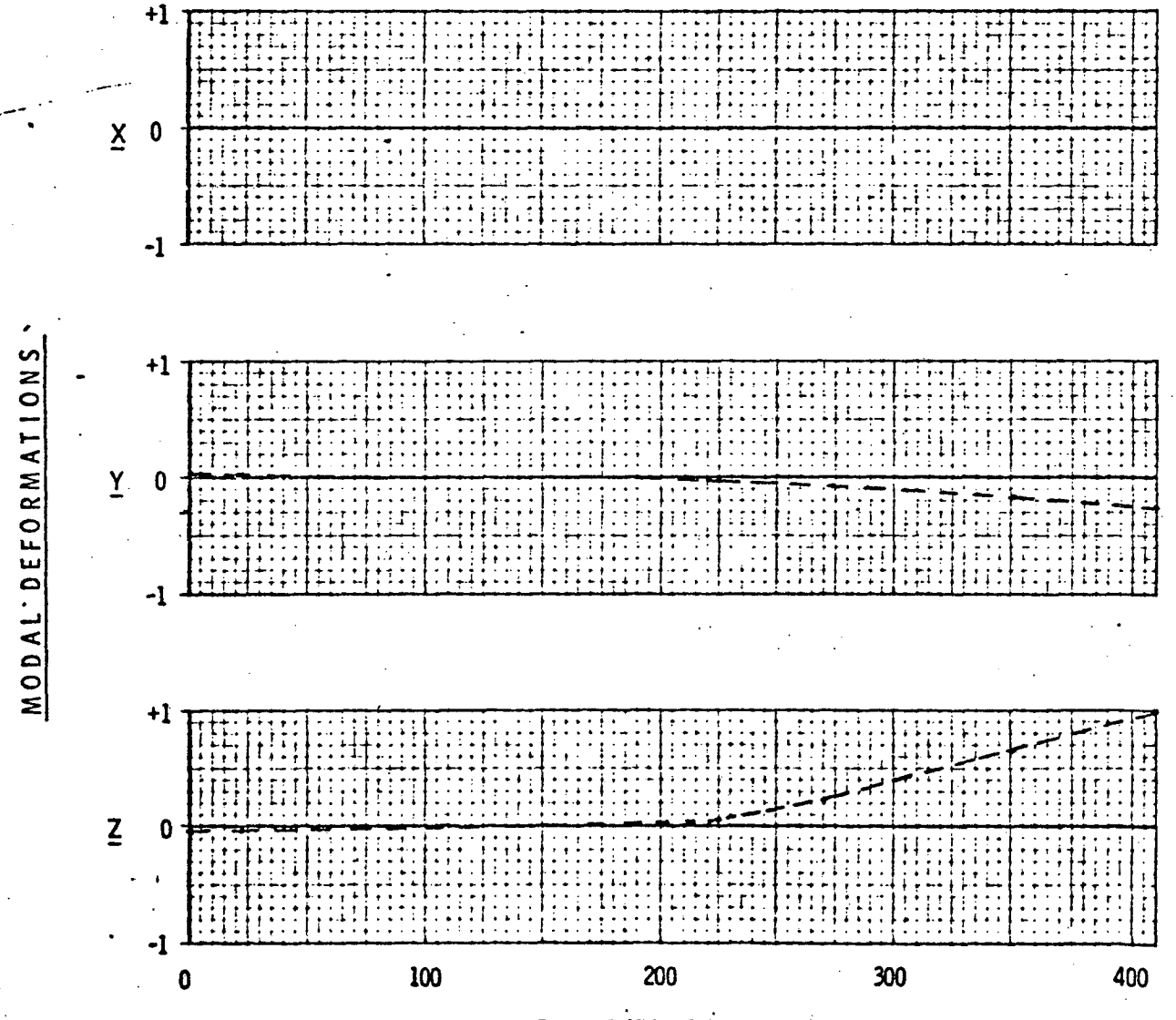


f = 24.053 Hz



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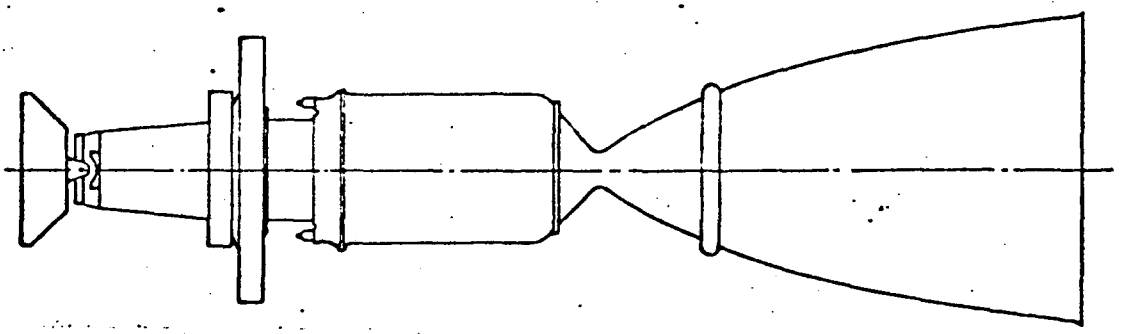
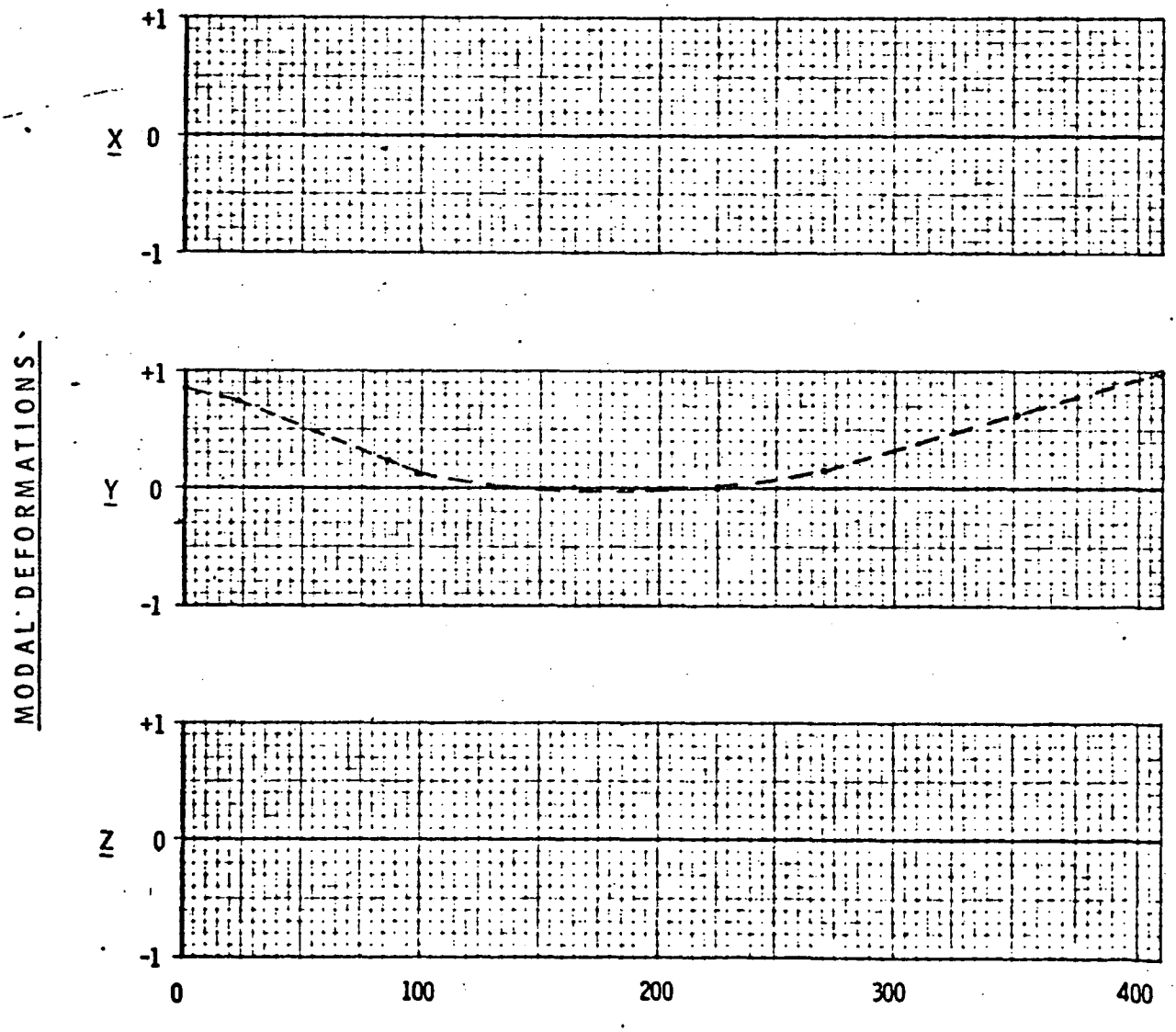


f = 27.494 Hz



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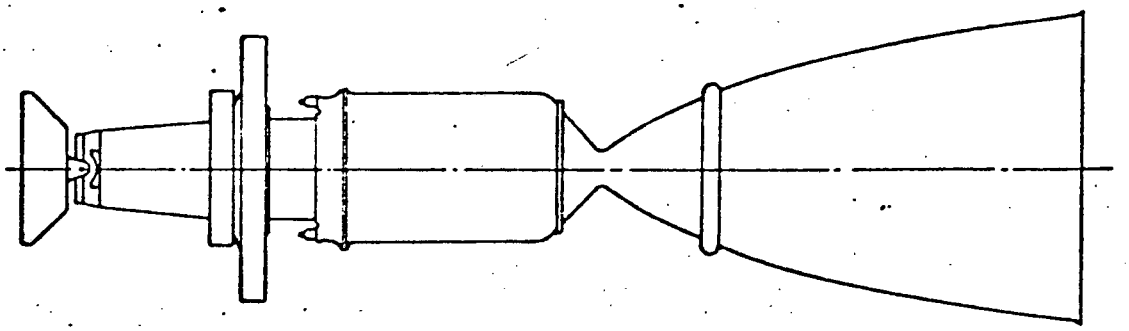
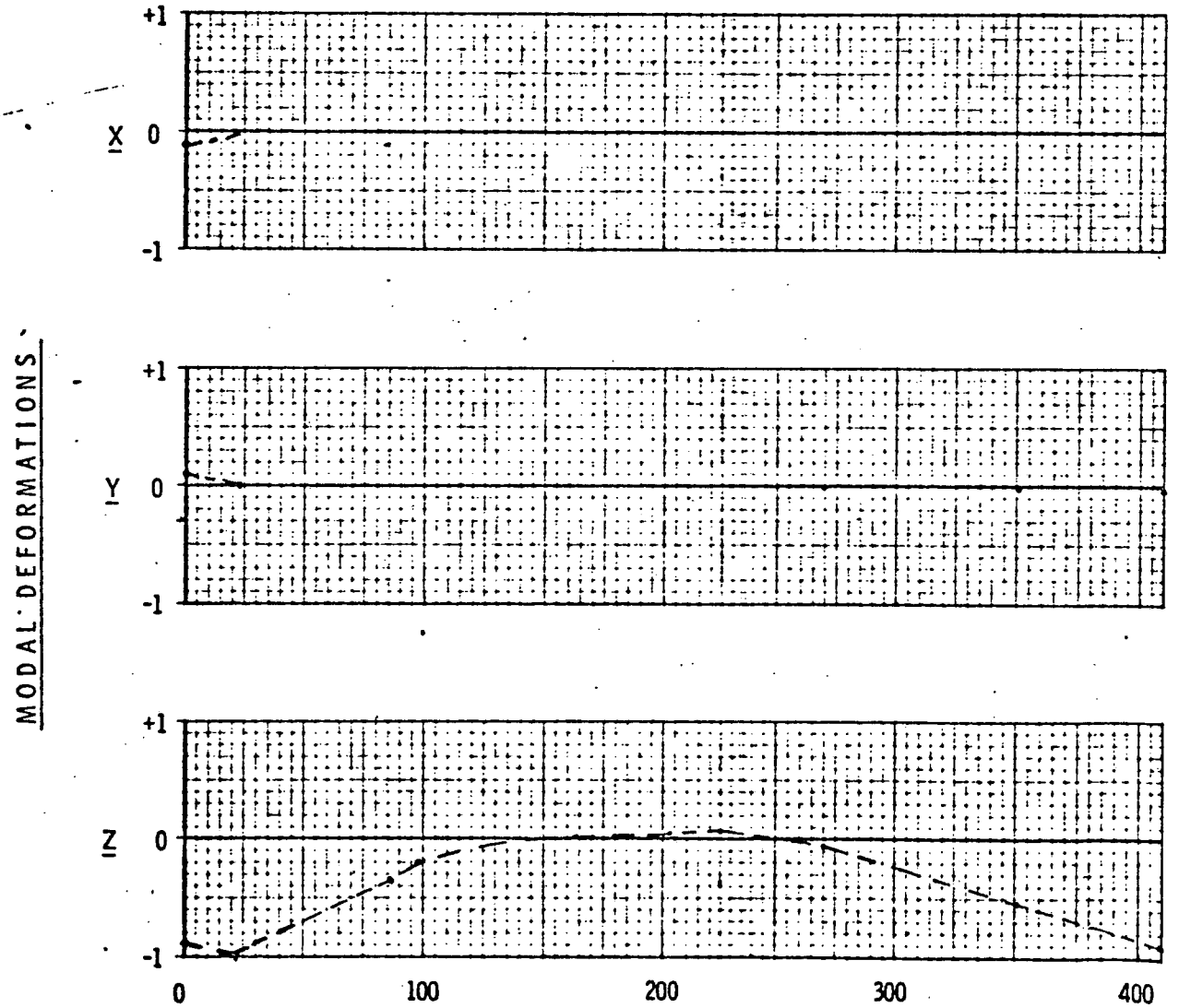


f = 31.428 Hz



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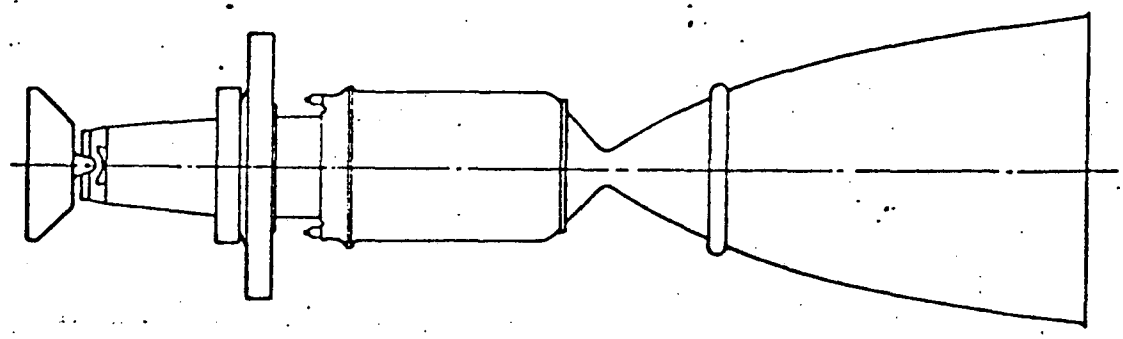


f = 33.956 Hz

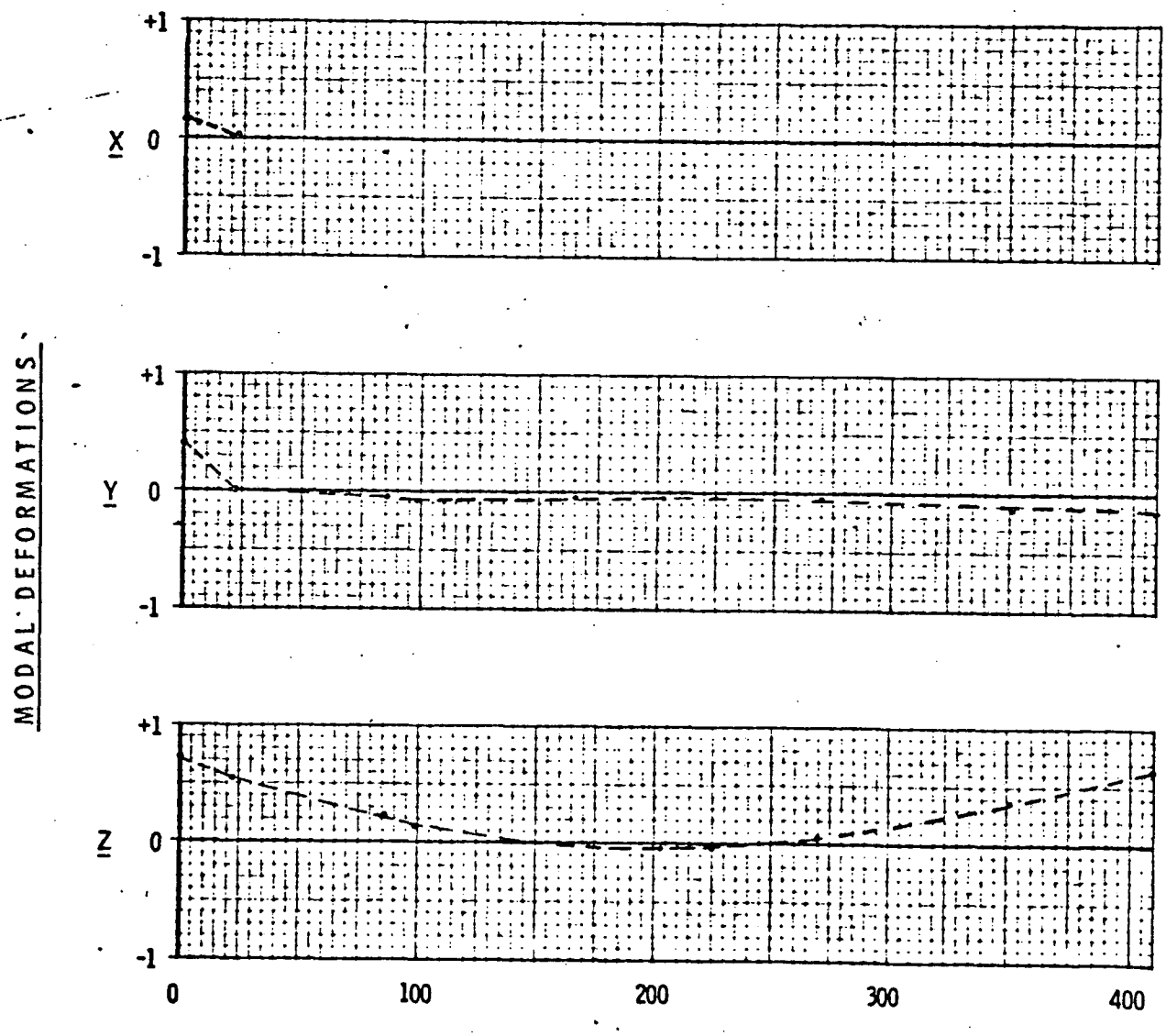
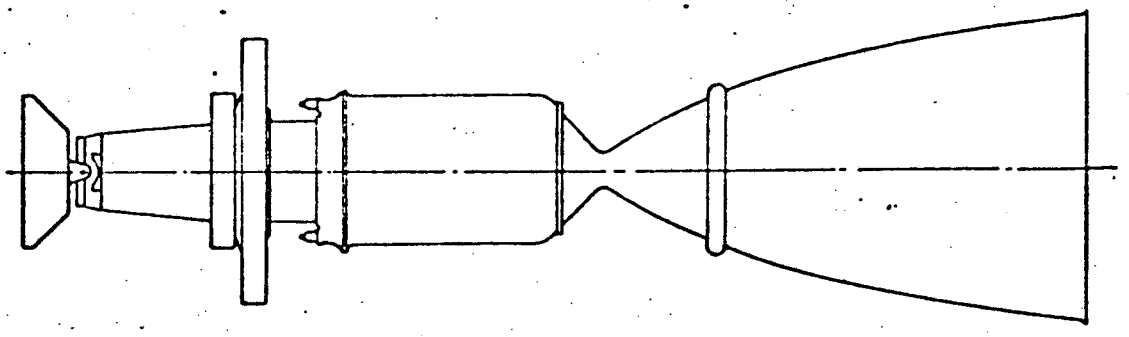


FIGURE 10-6



f = 36.942 Hz

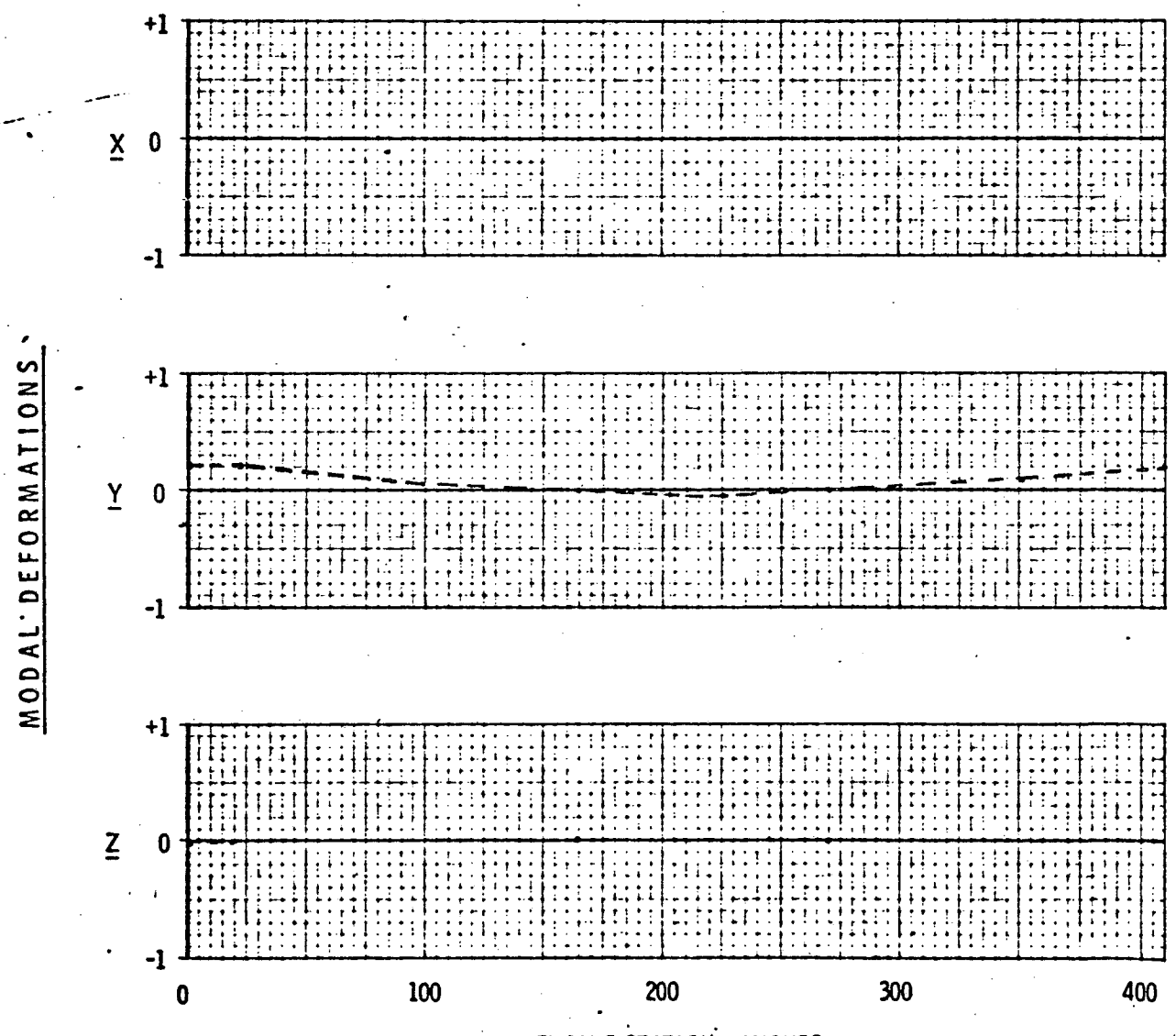
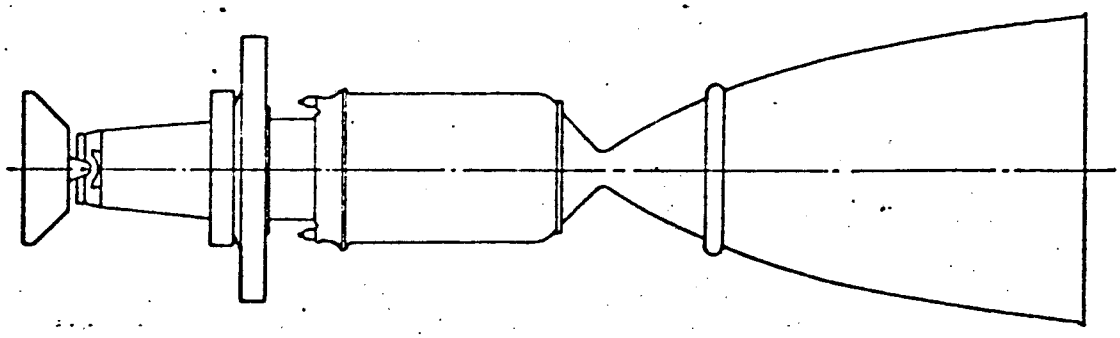


FIGURE 10-7



f = 40.47 Hz

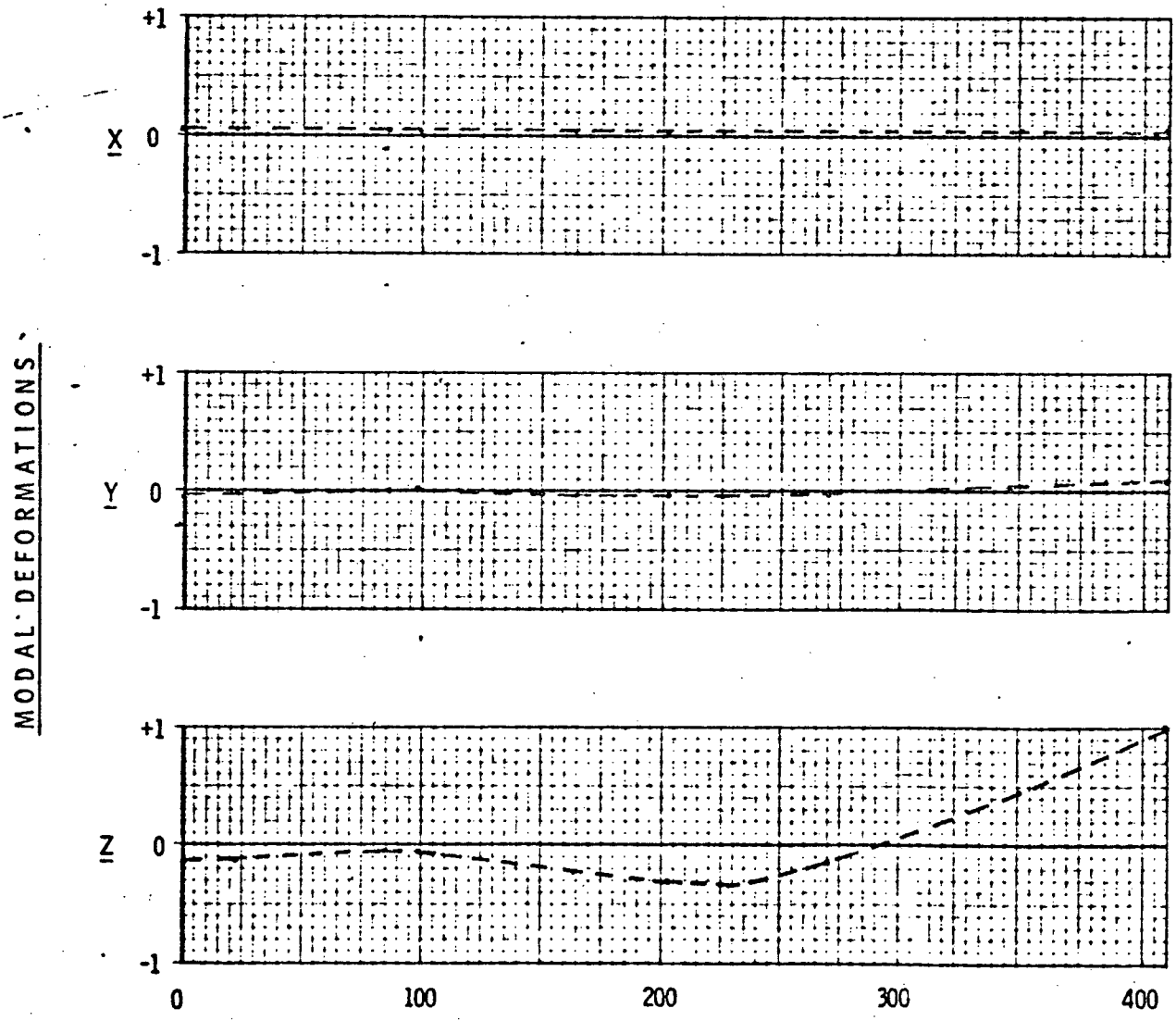
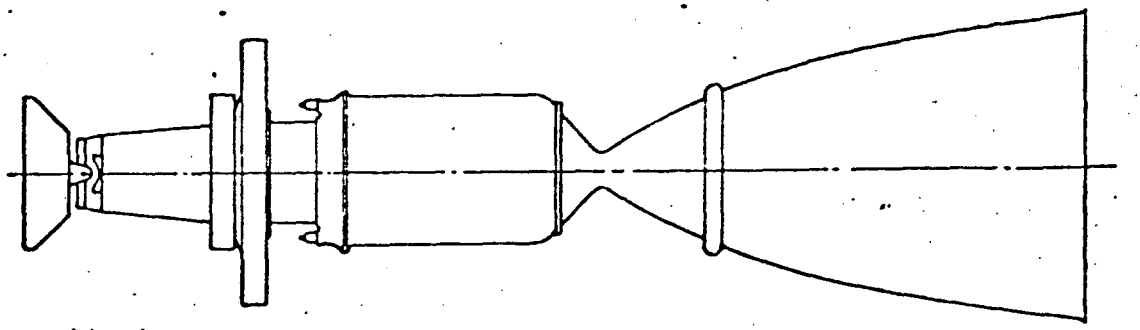


FIGURE 10-8



f = 40.91 Hz

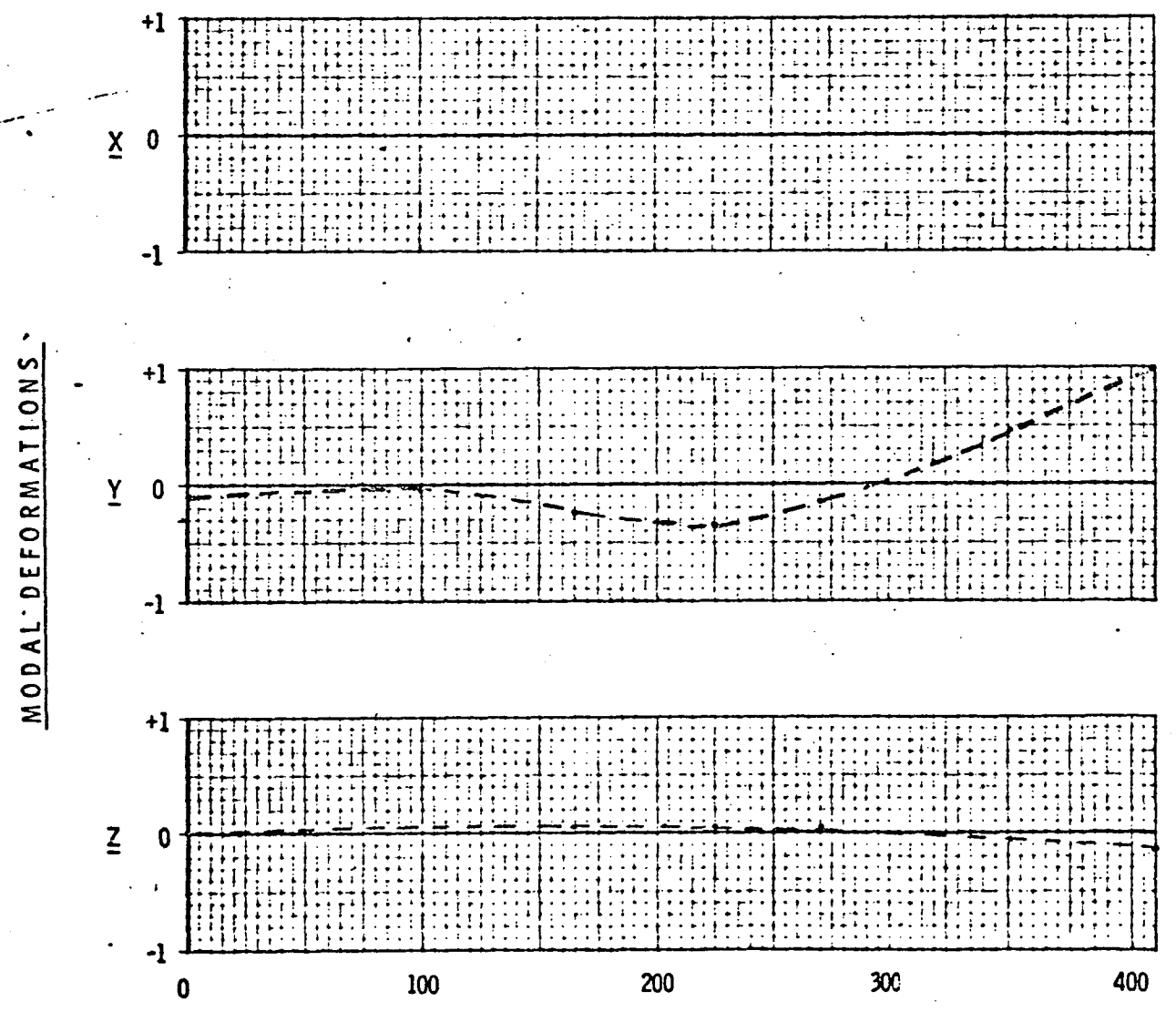
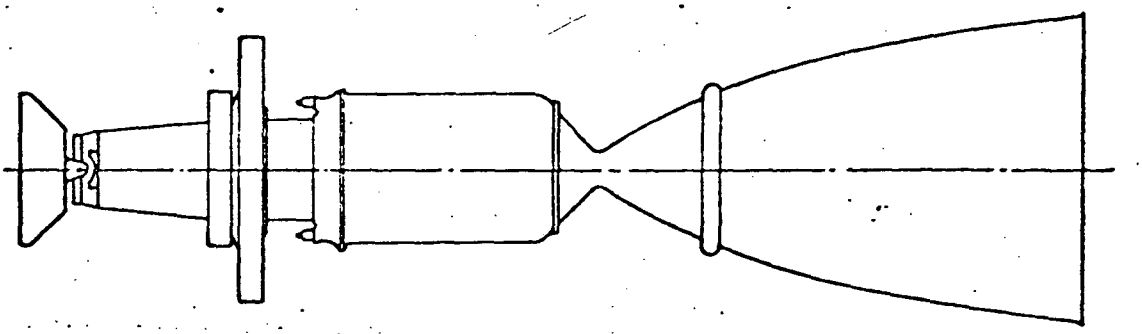


FIGURE 10-9



f = 41.80 Hz

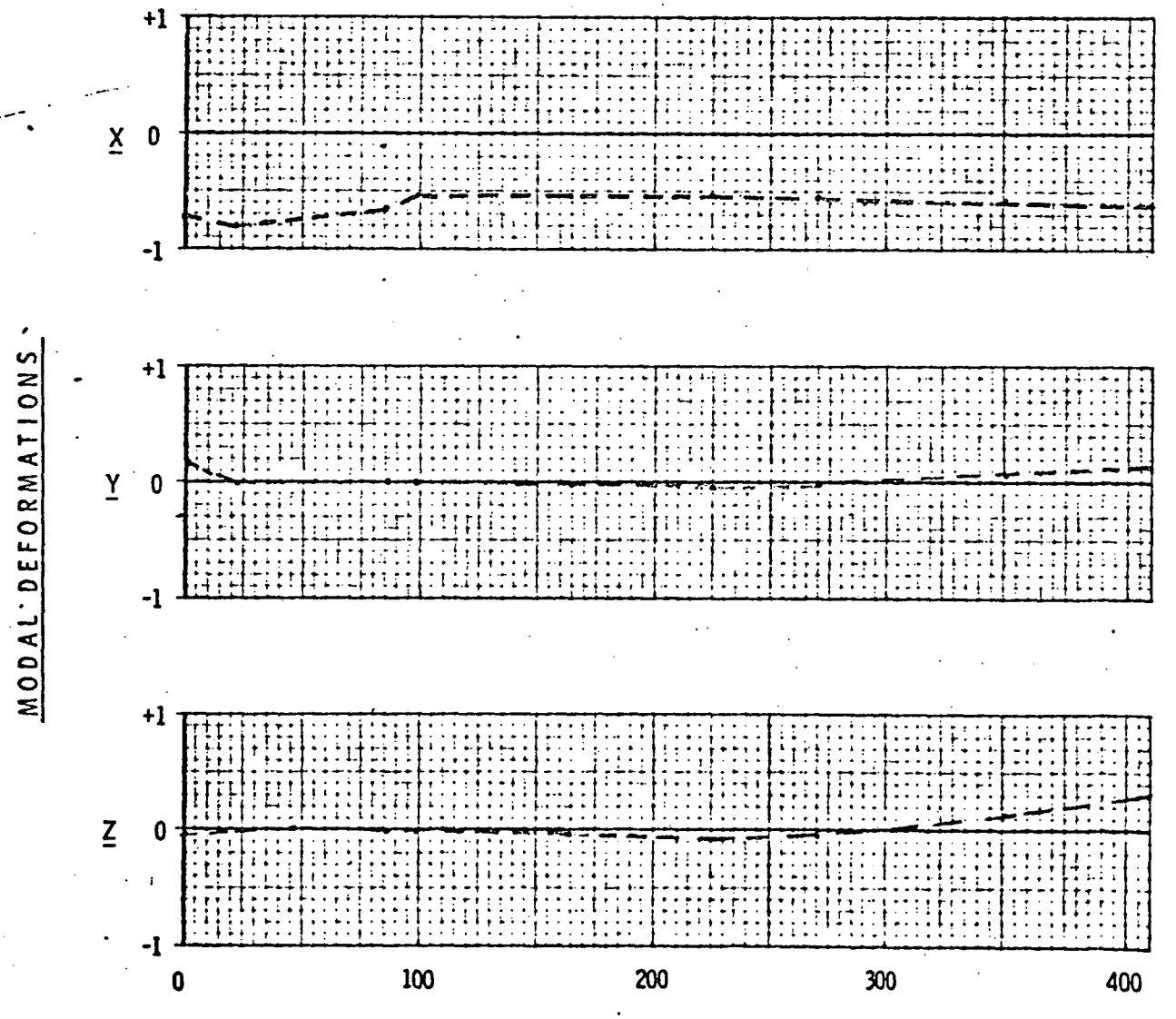
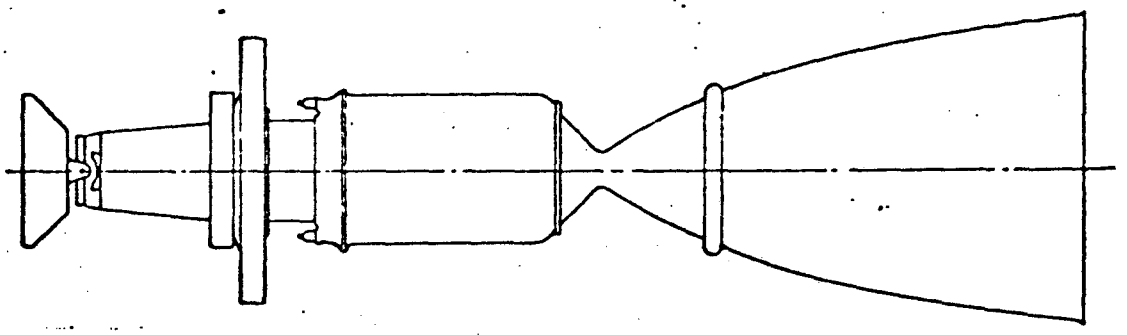


FIGURE 10-10



f = 56.98 Hz

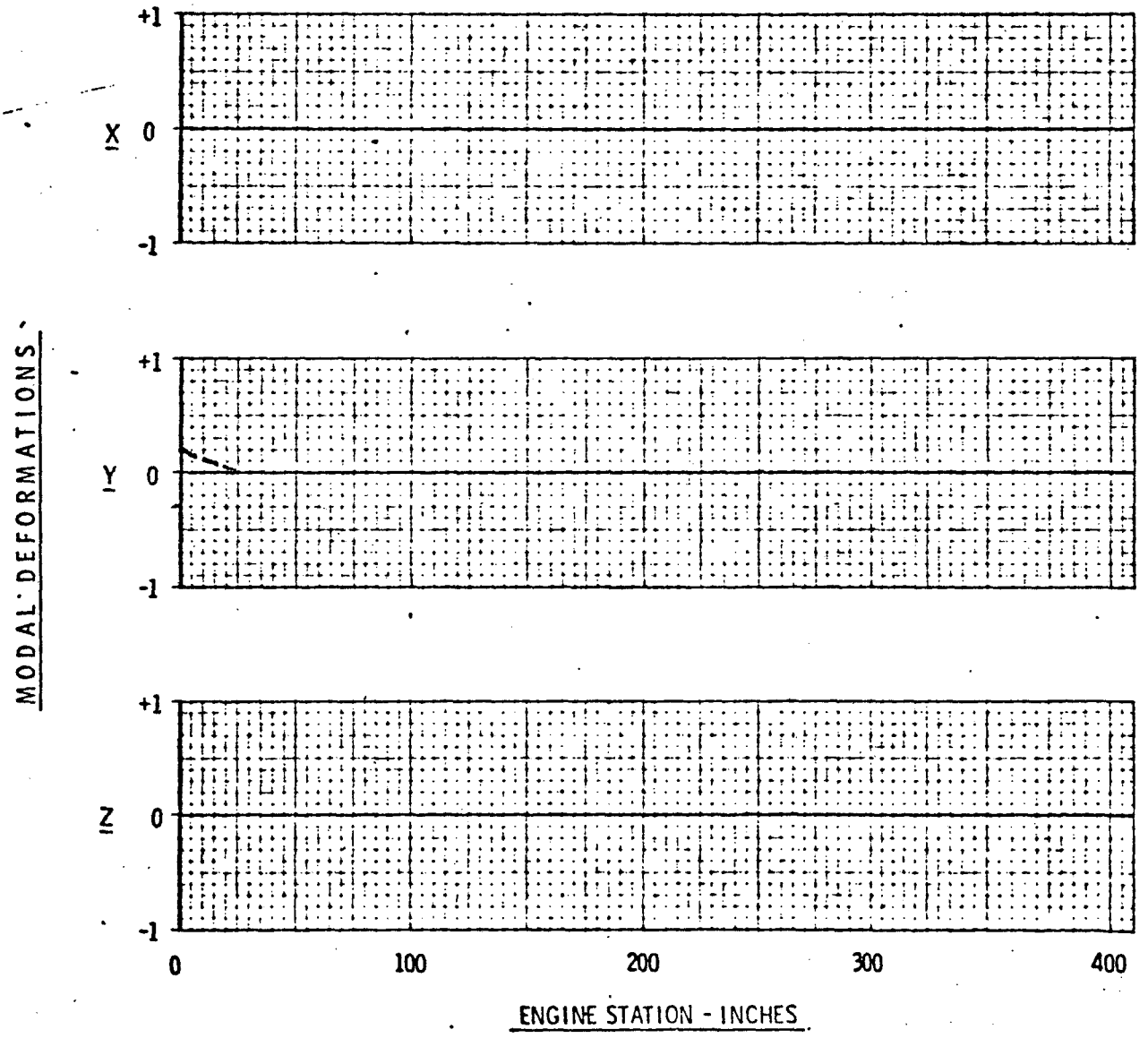
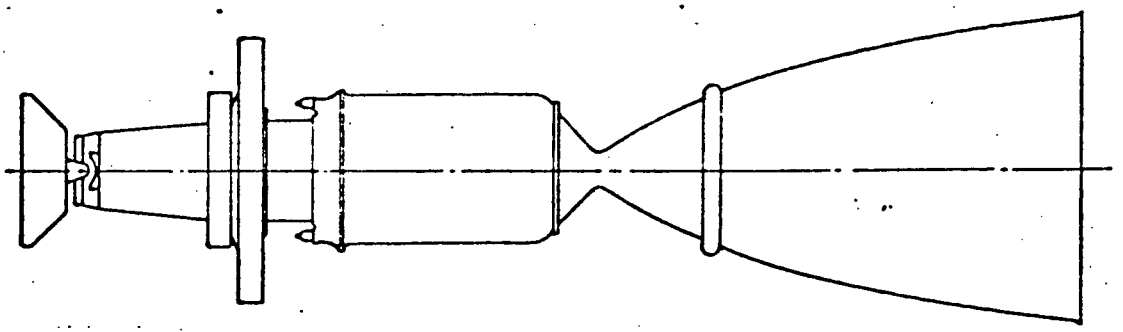


FIGURE 10-11



f = 58.98 Hz

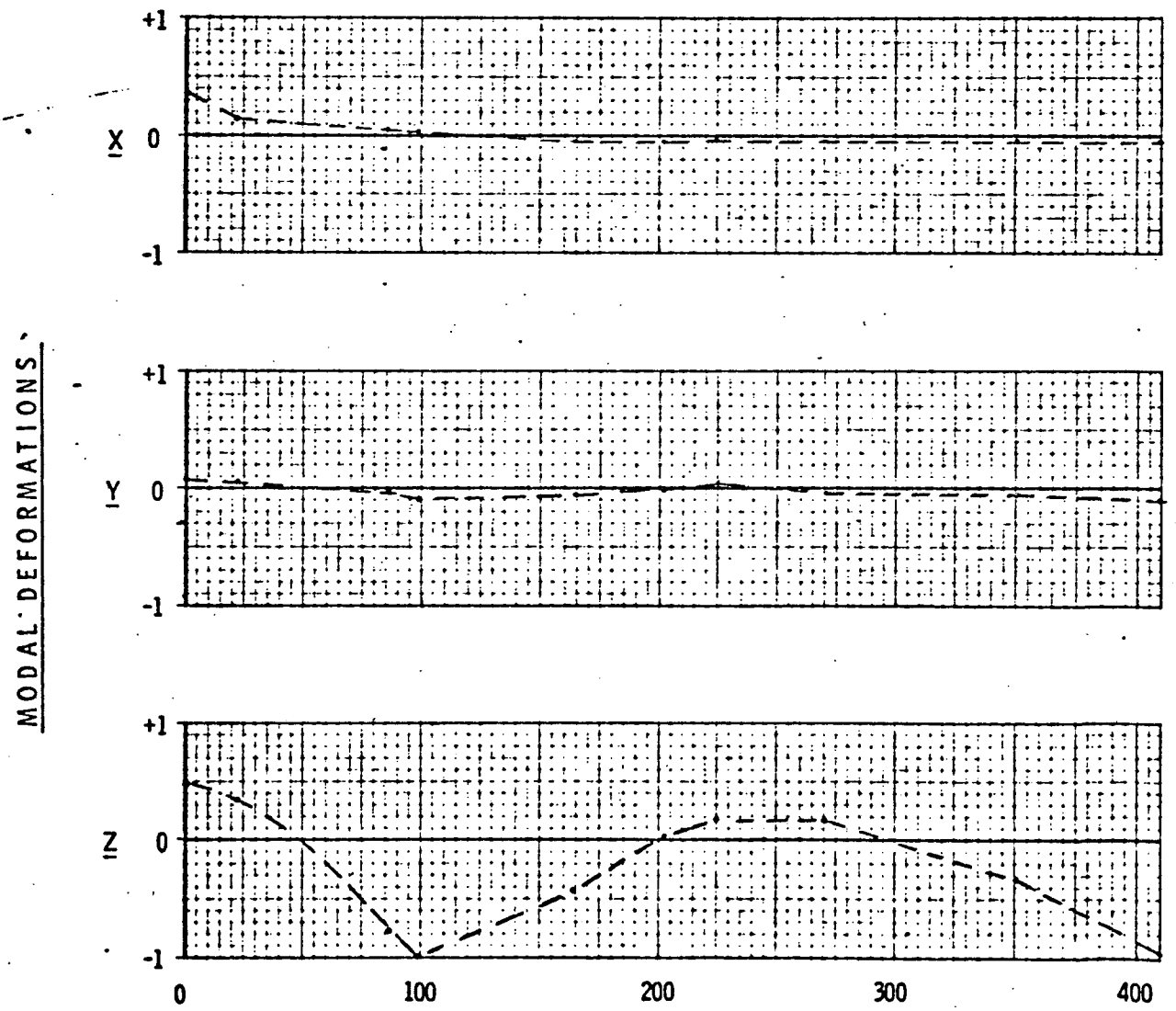
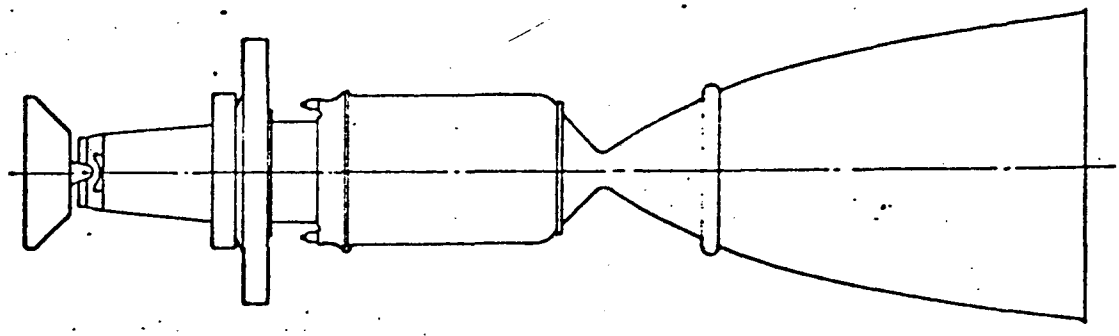


FIGURE 10-12



f = 61.02 Hz

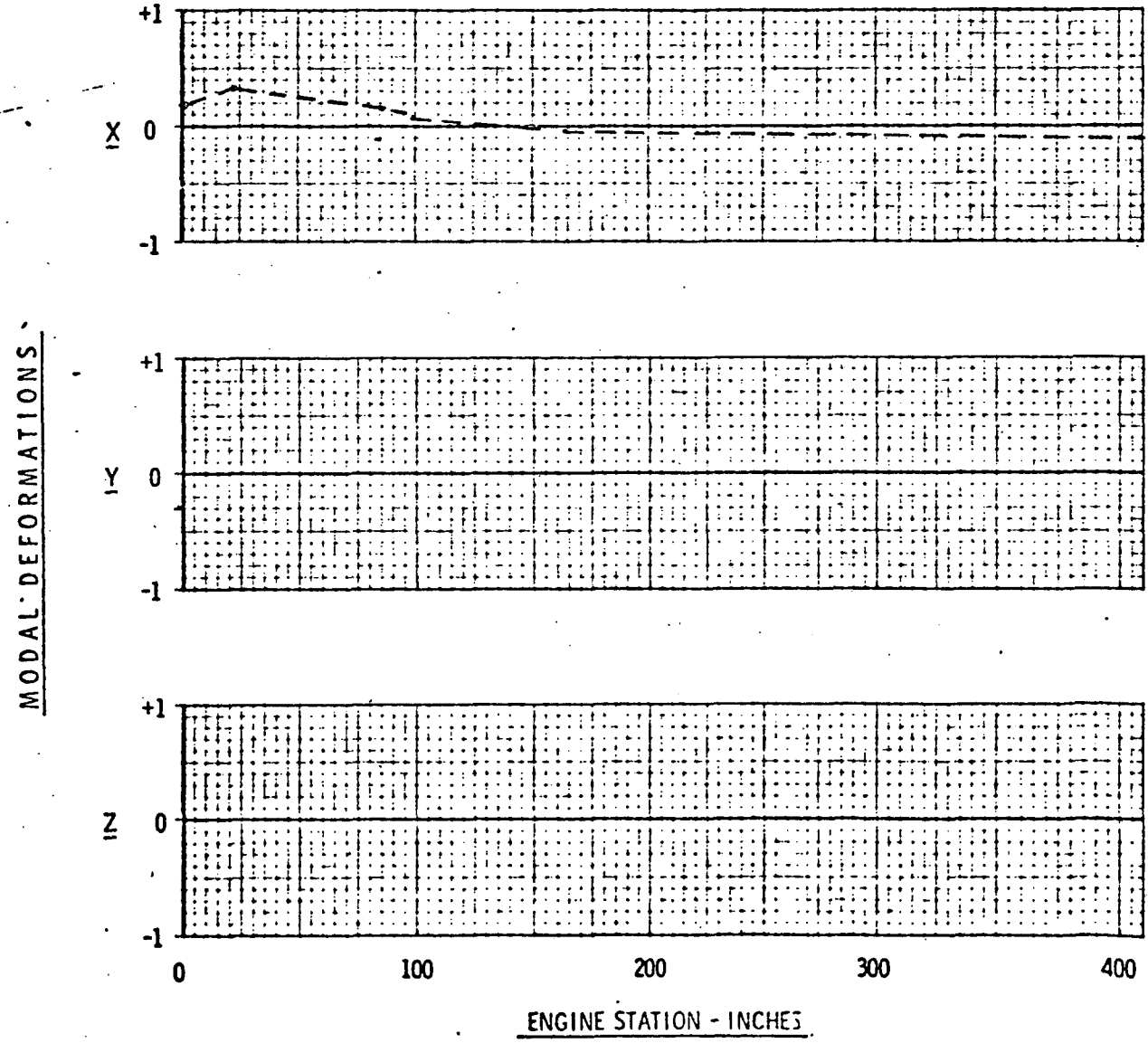
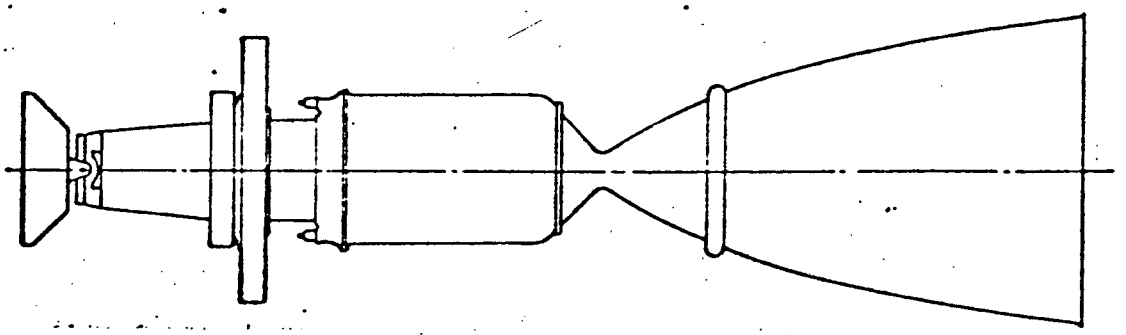


FIGURE 10-13



f = 61.4 Hz

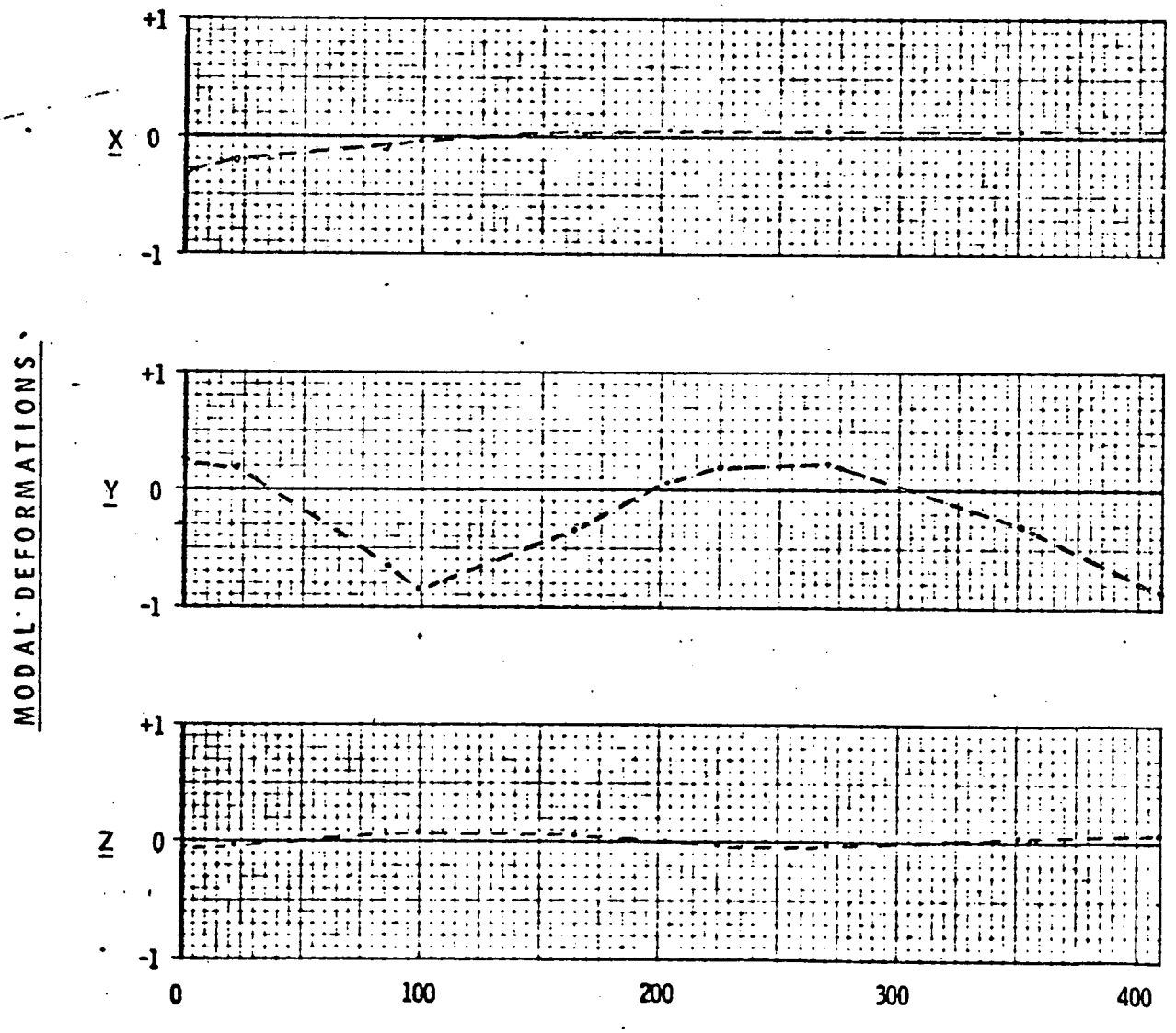
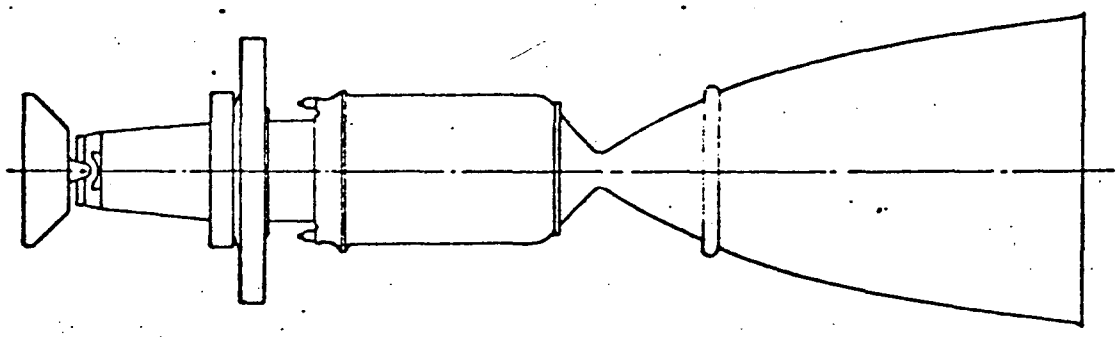


FIGURE 10-14



f = 63.15 Hz

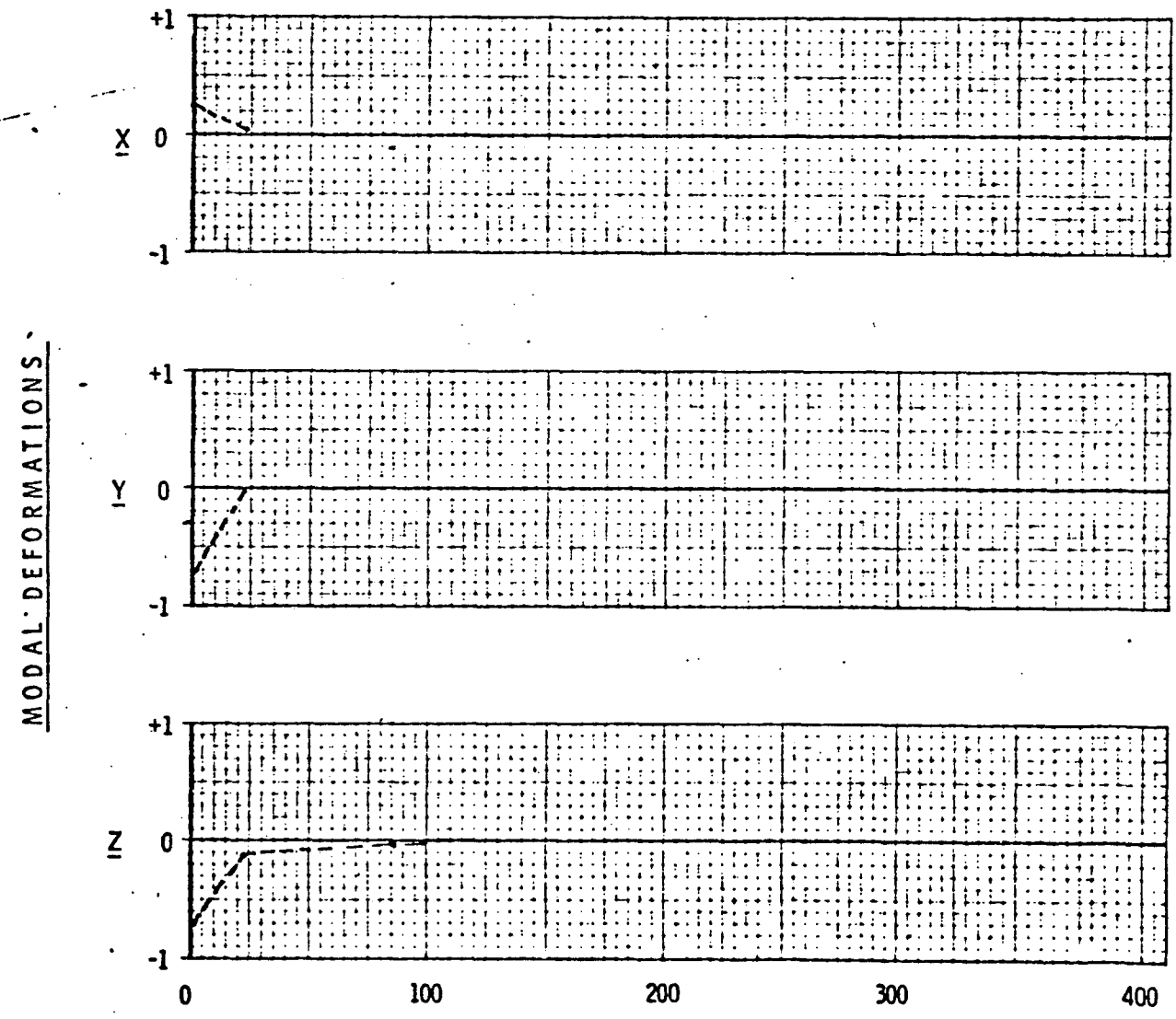
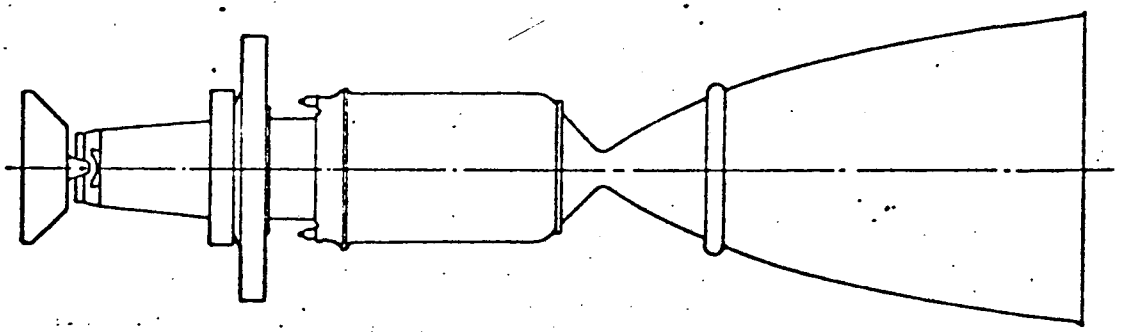


FIGURE 10-15



f = 72.96 Hz

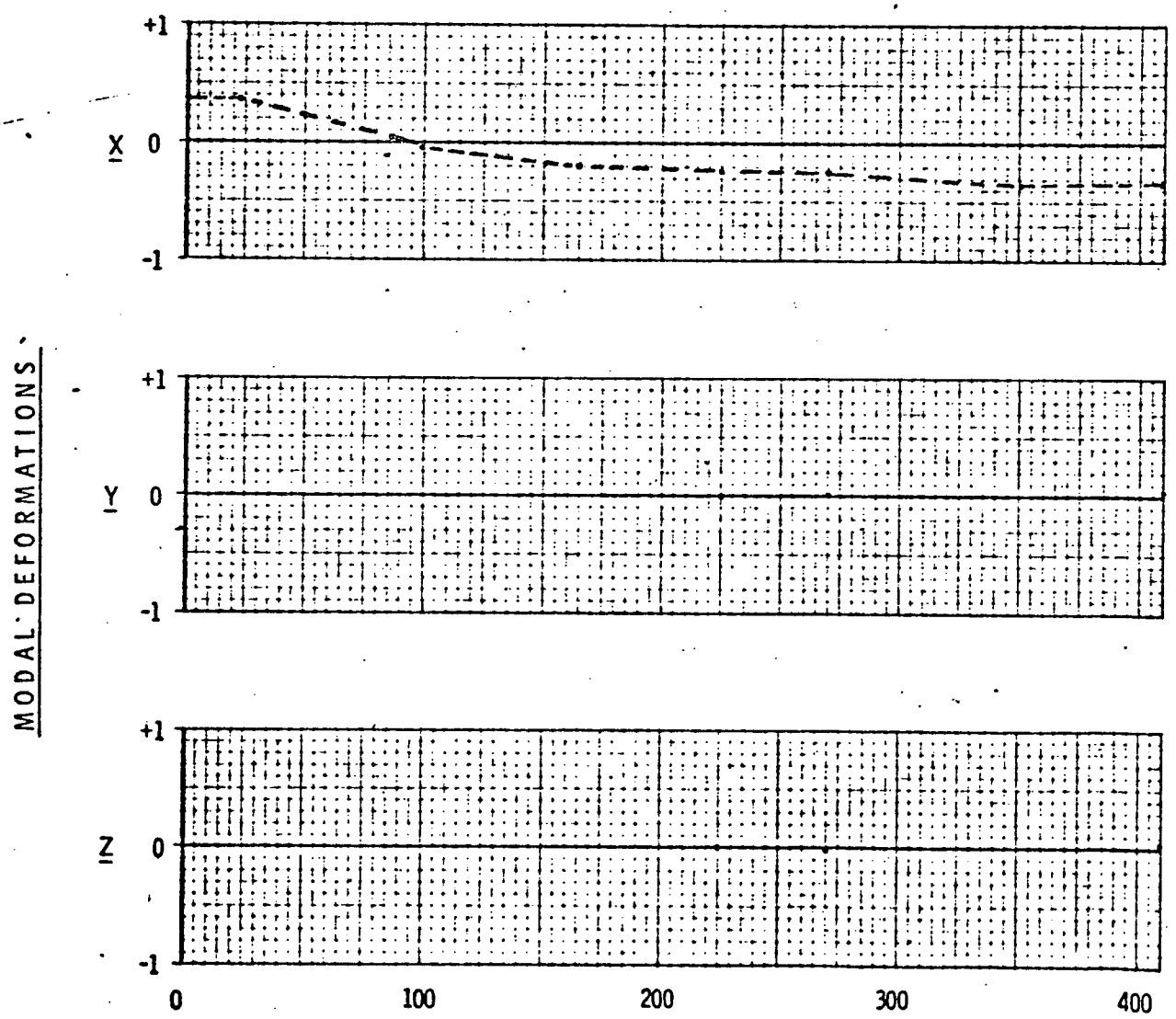
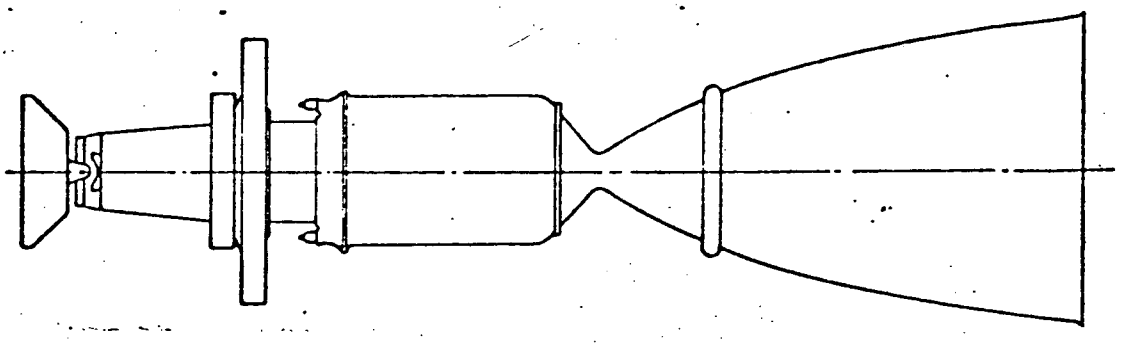


FIGURE 11-1



f = 24.074 Hz

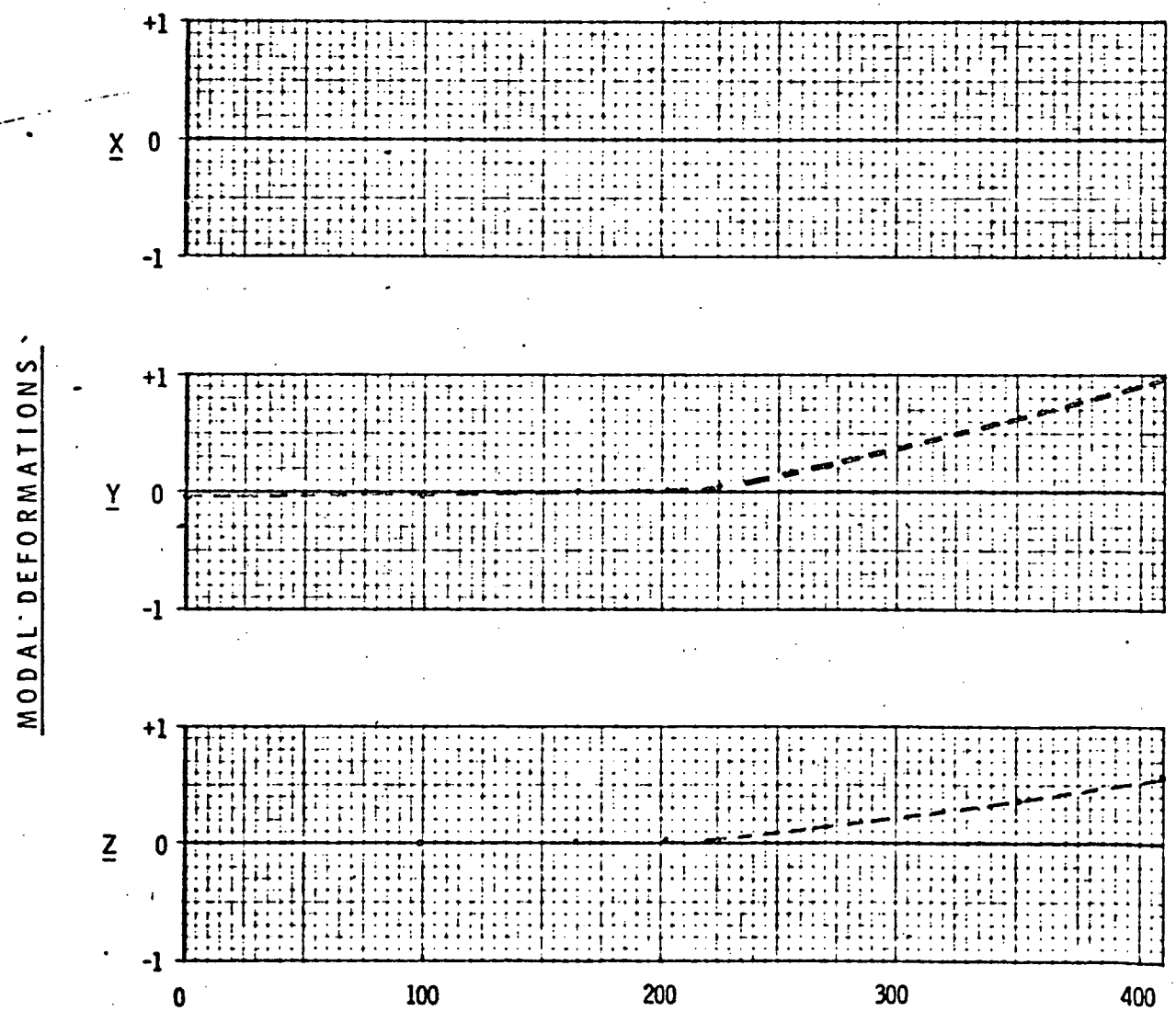
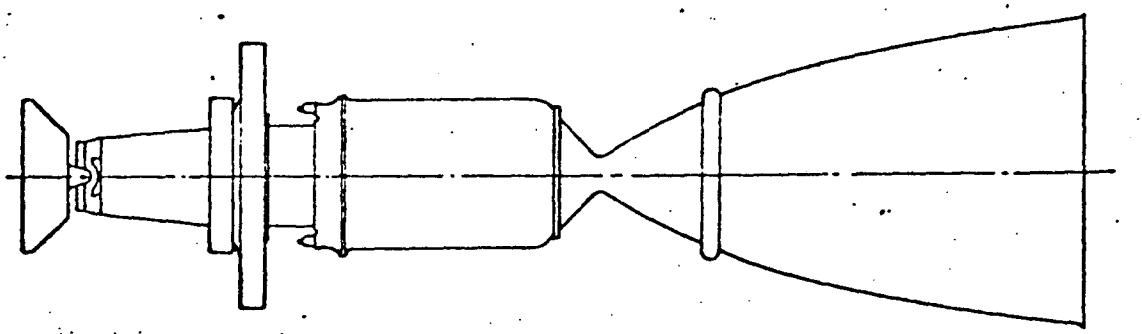


FIGURE 11-2



f = 24.141 Hz

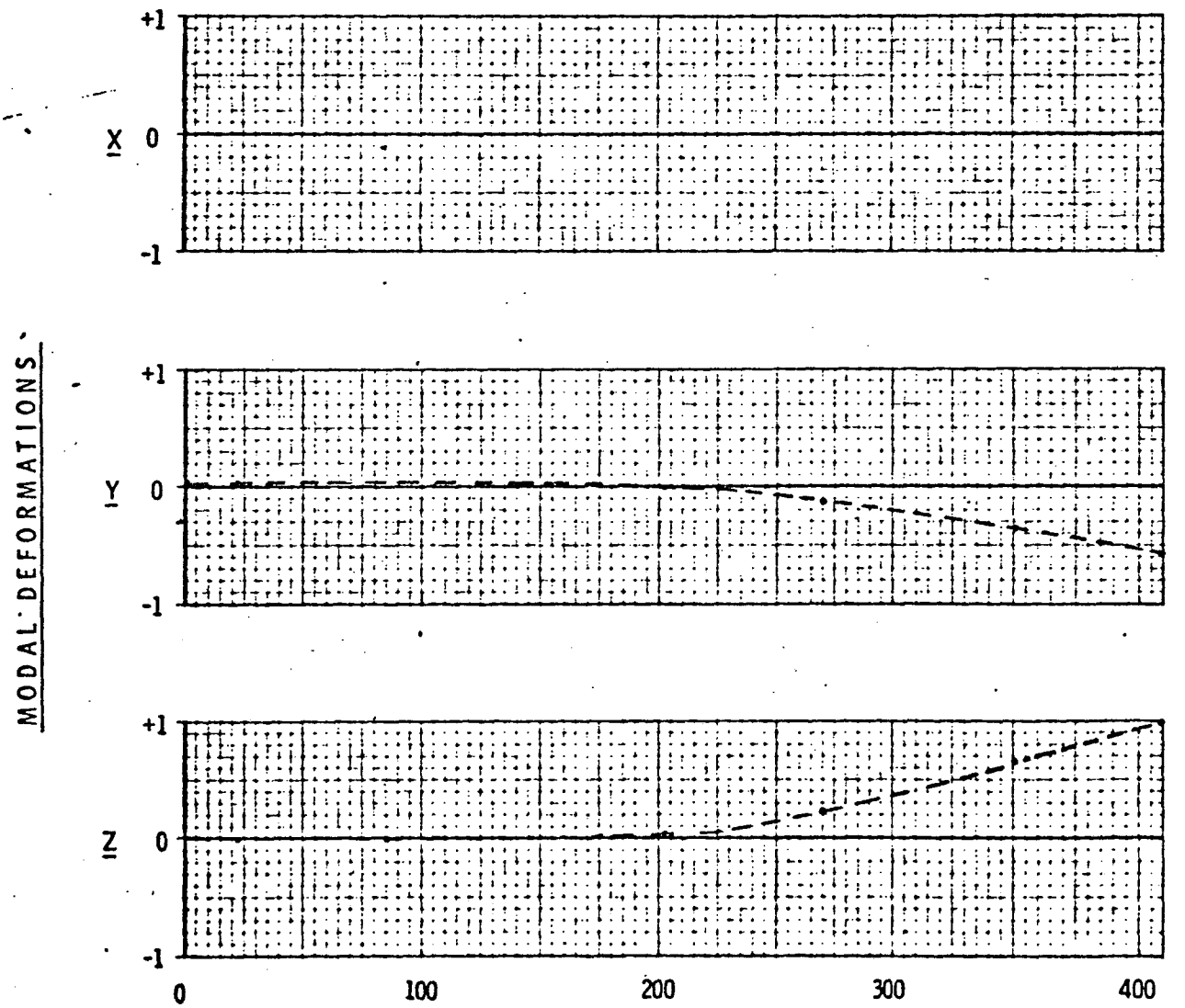
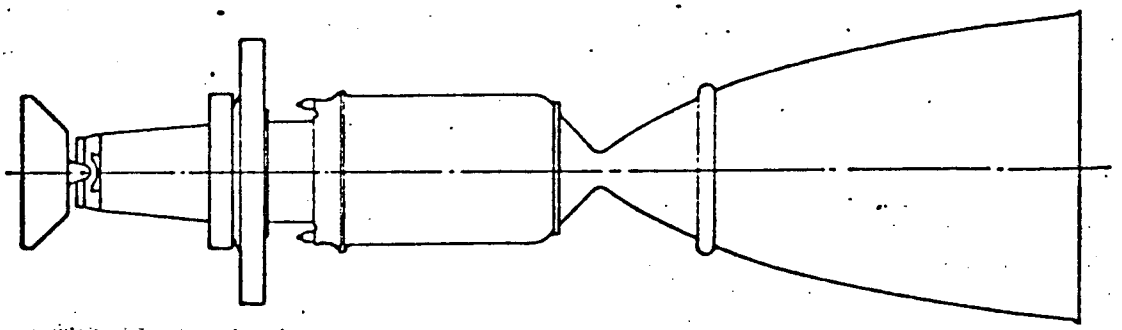


FIGURE 11-3



f = 31.28 Hz

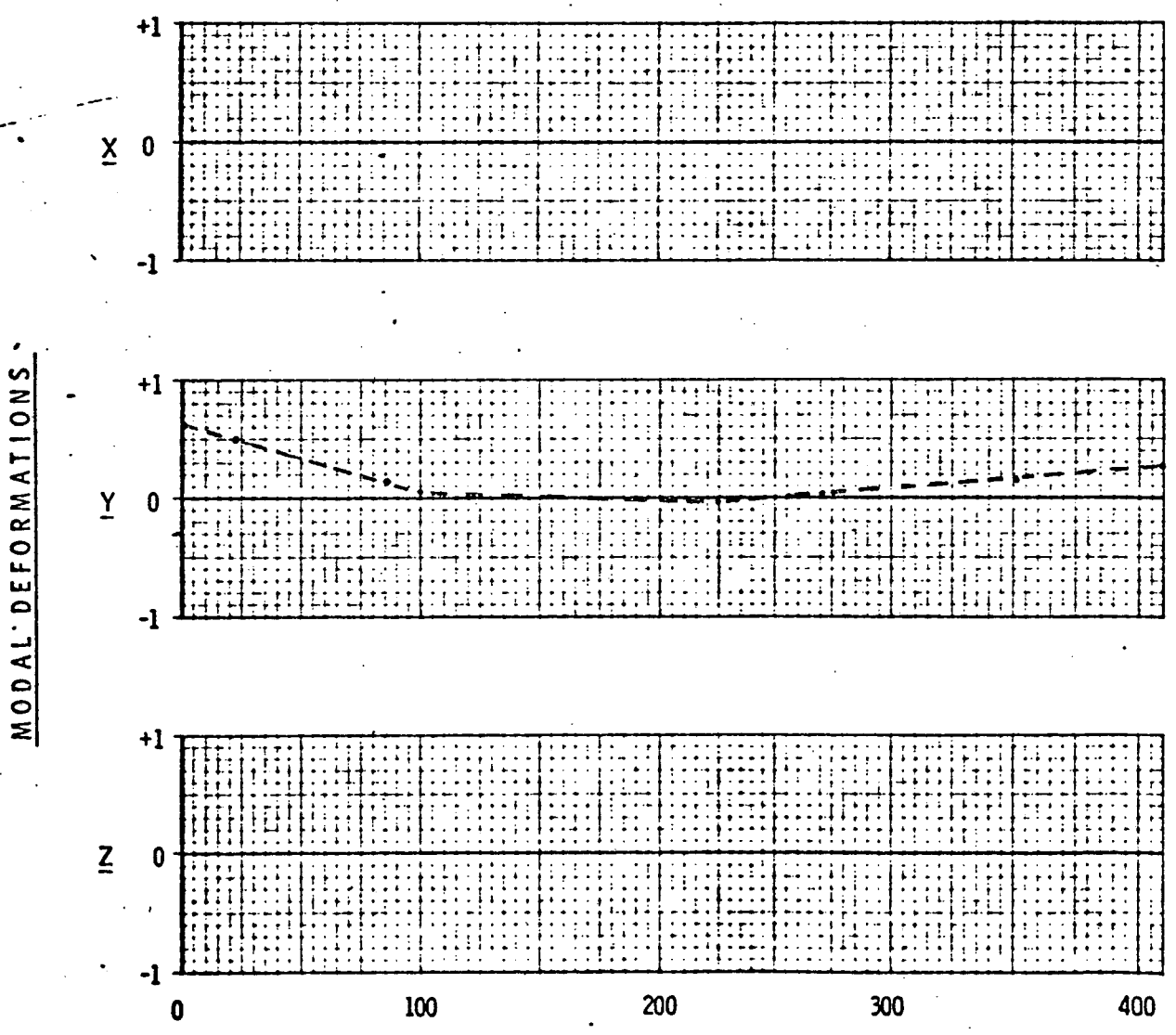
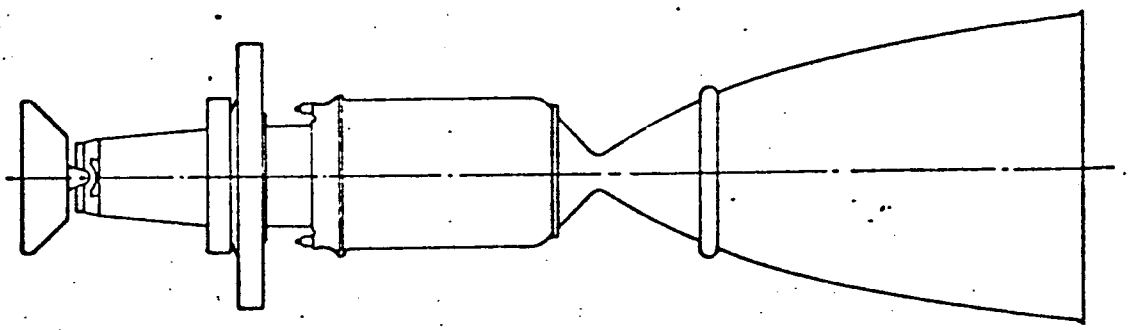


FIGURE 11-4



f = 39.26 Hz

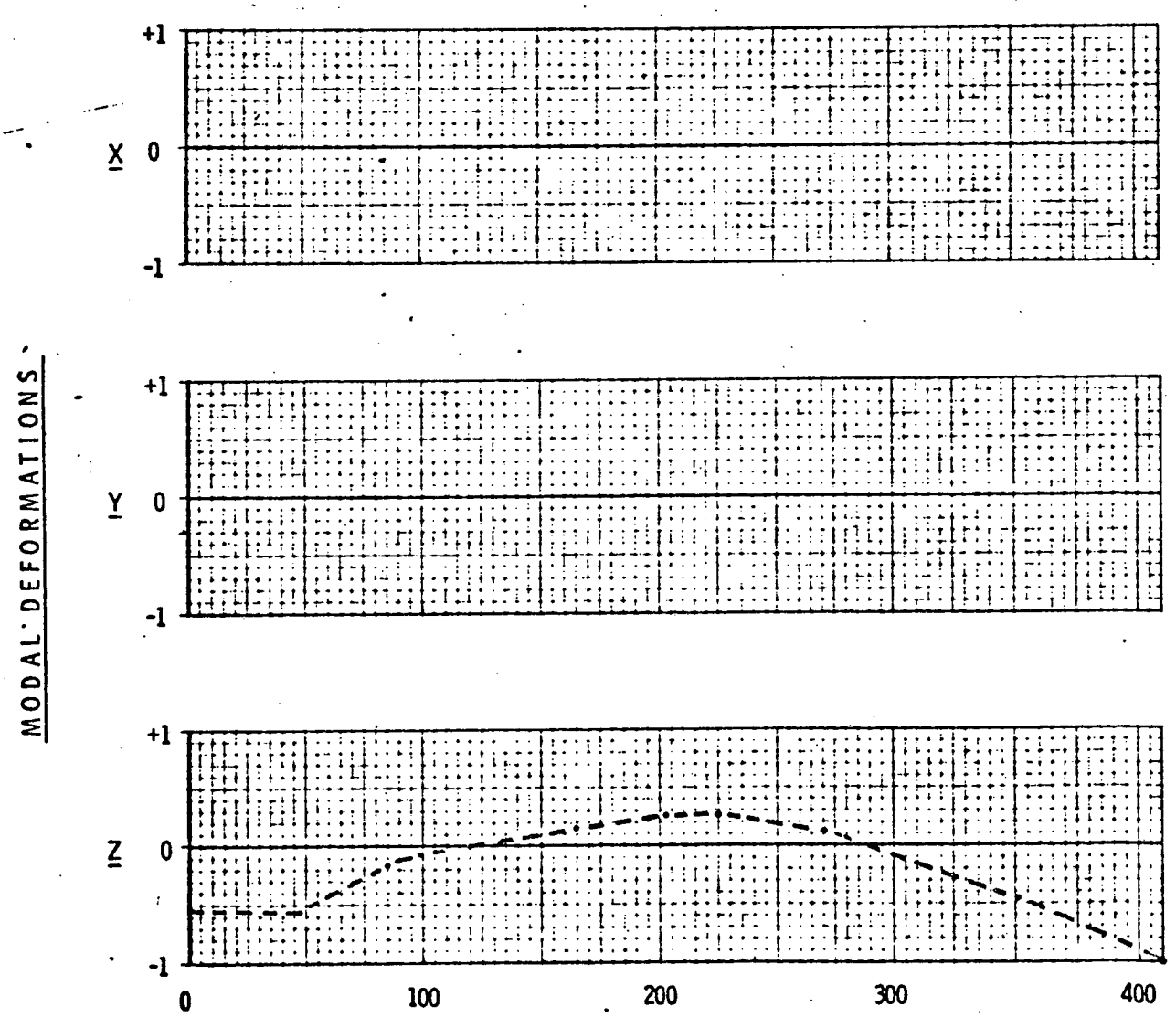
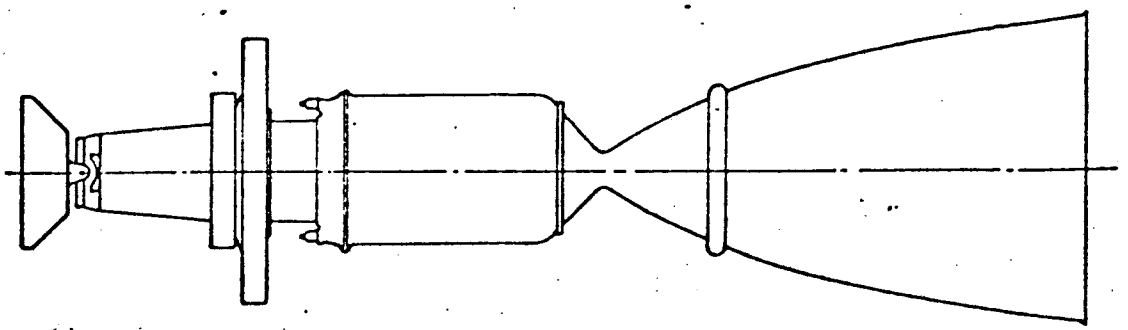


FIGURE 11-5



f = 40.28 Hz

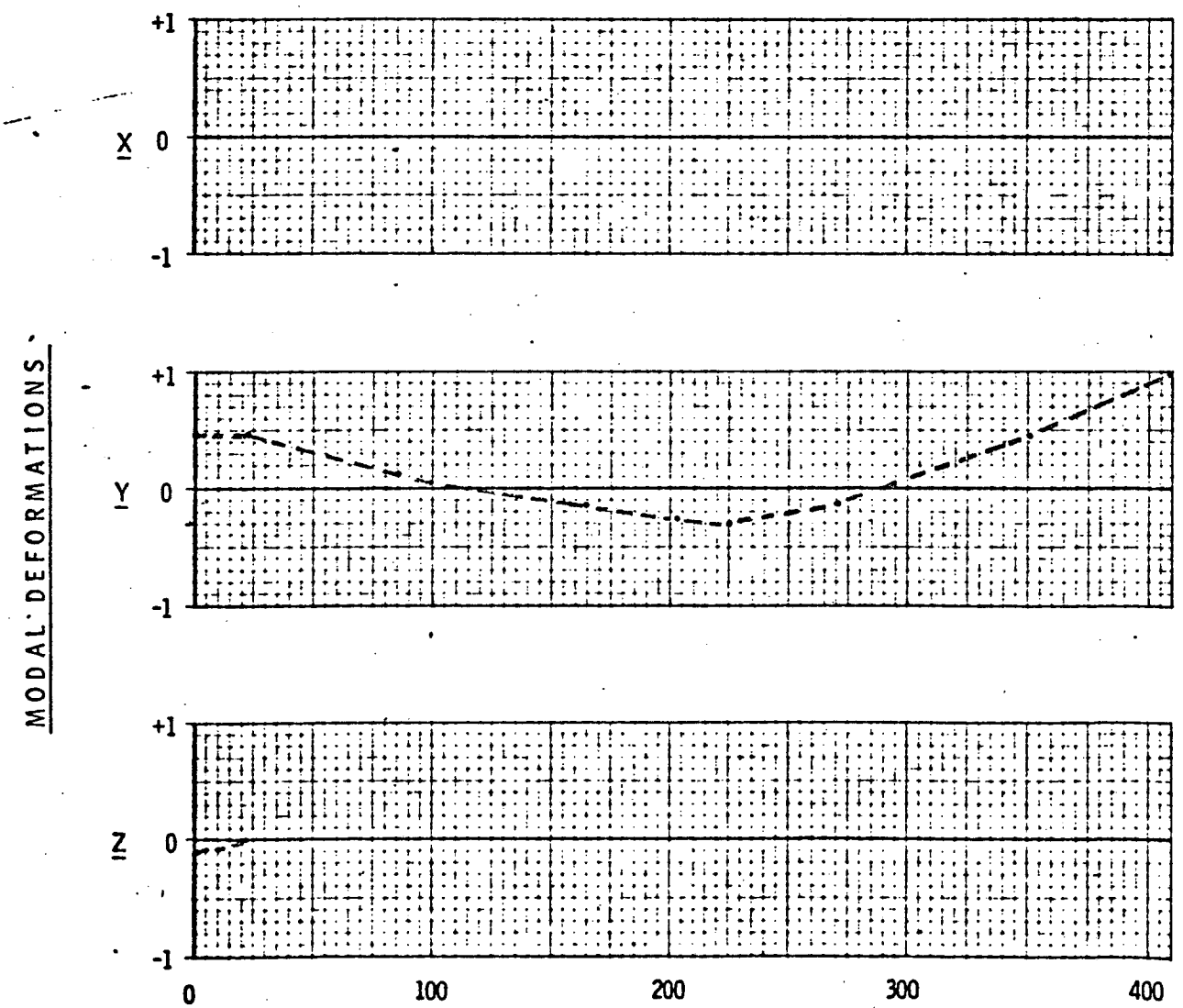
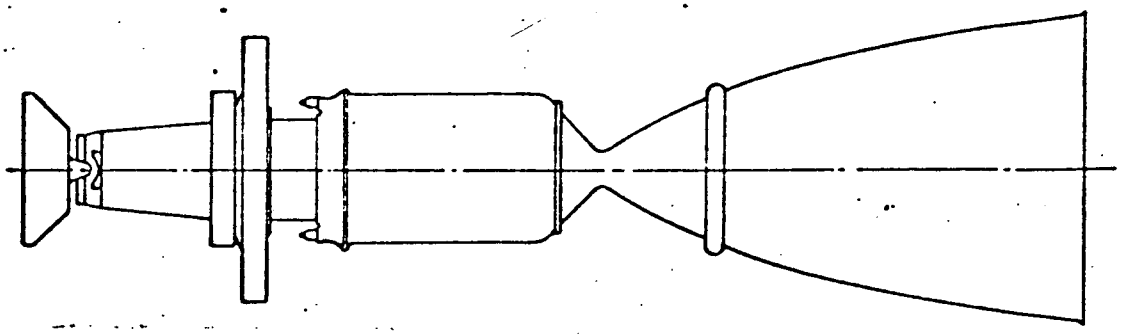


FIGURE 11-6



f = 41.95 Hz

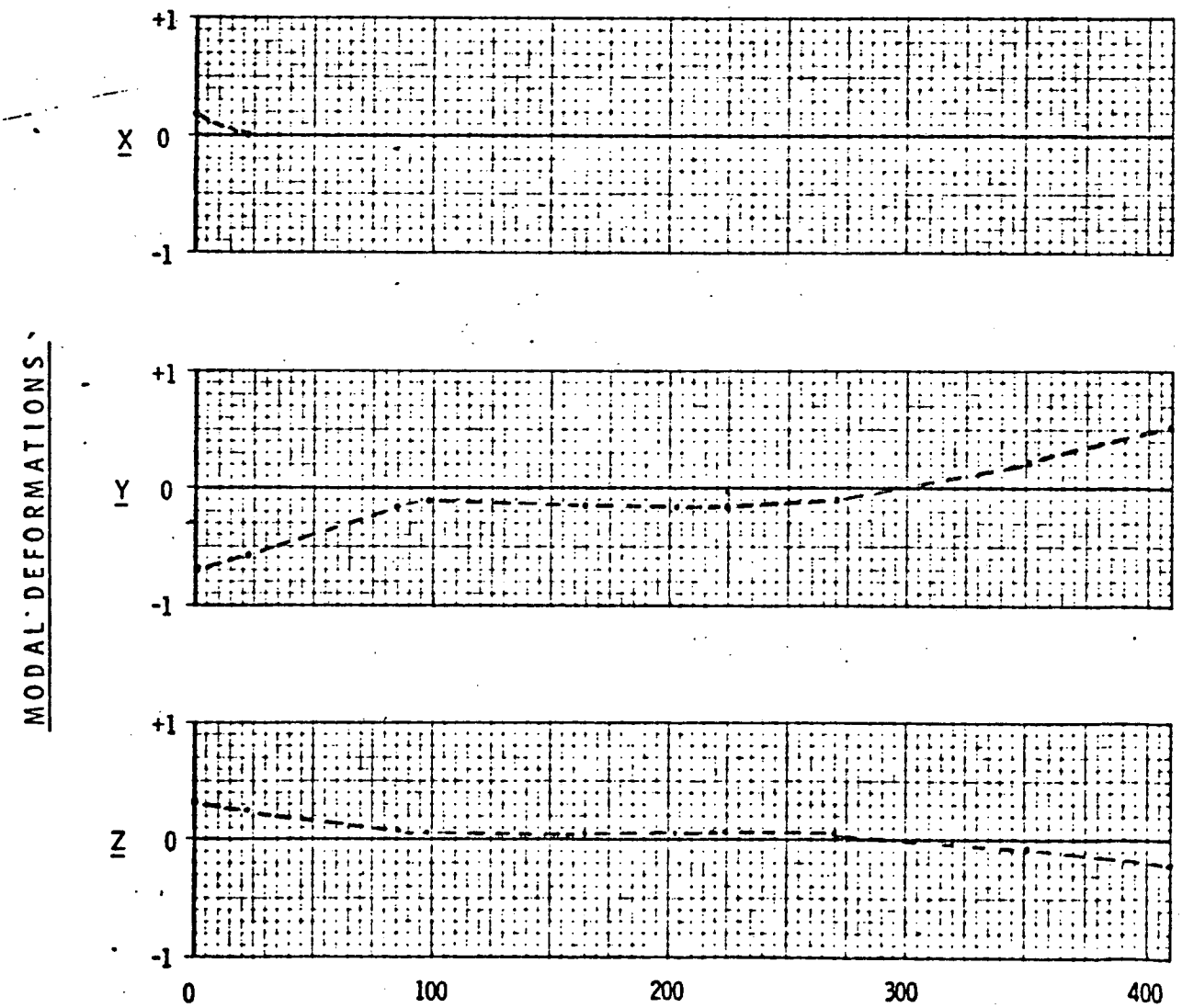
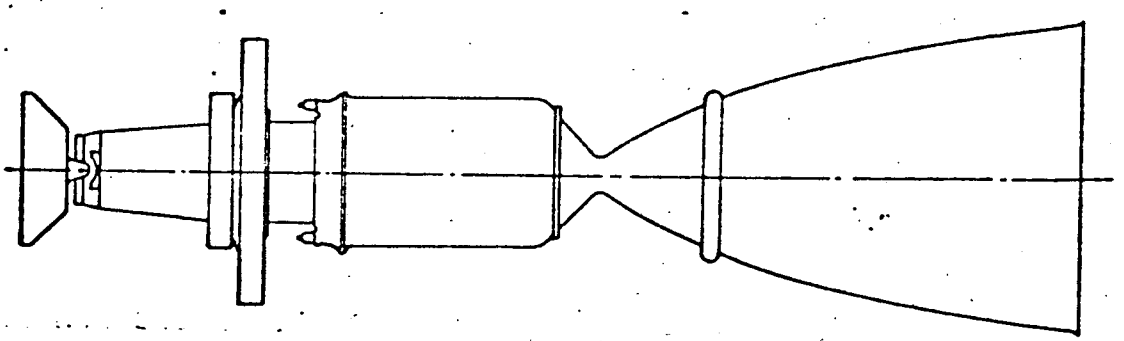


FIGURE 11-7



f = 42.25 Hz

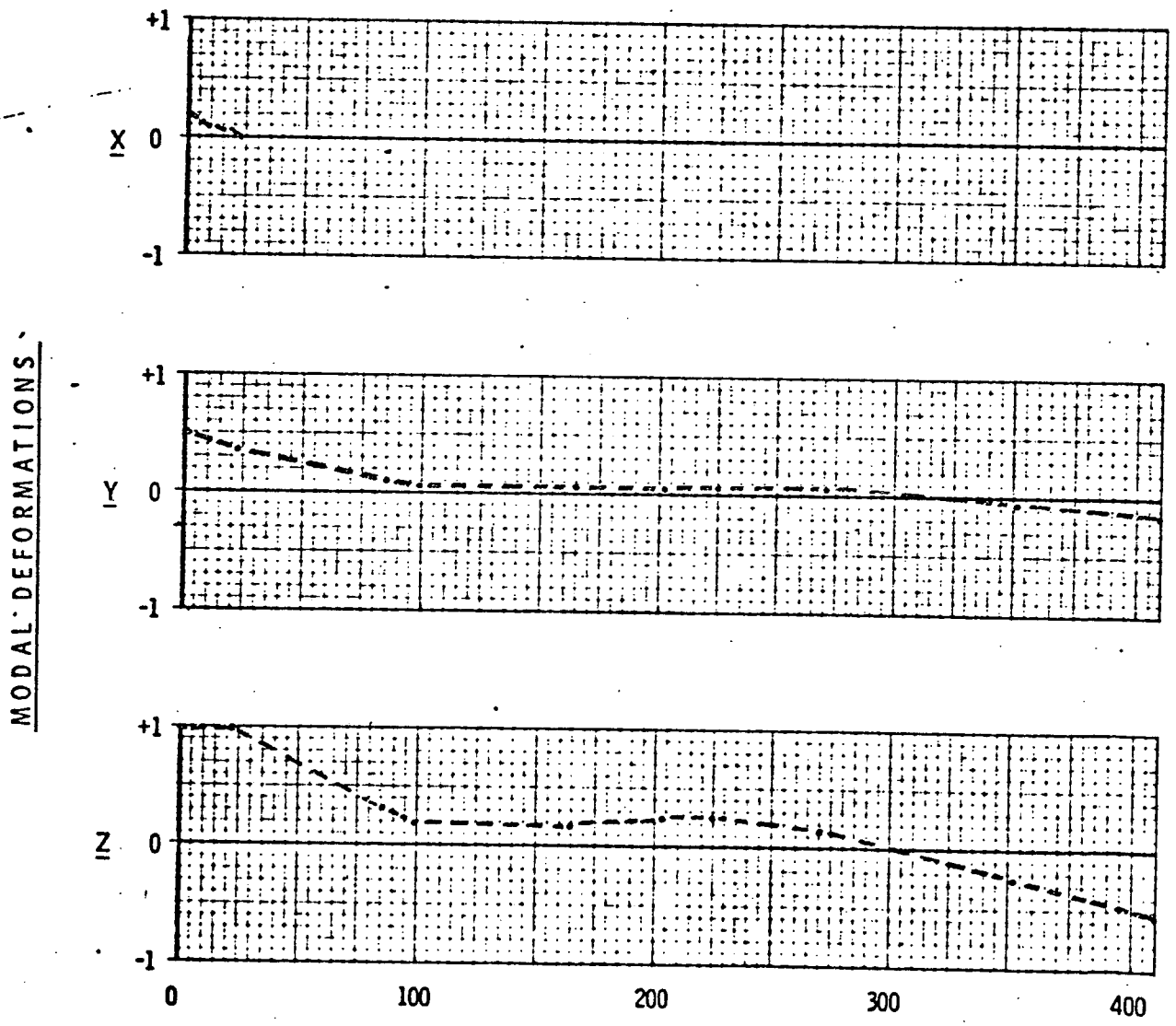
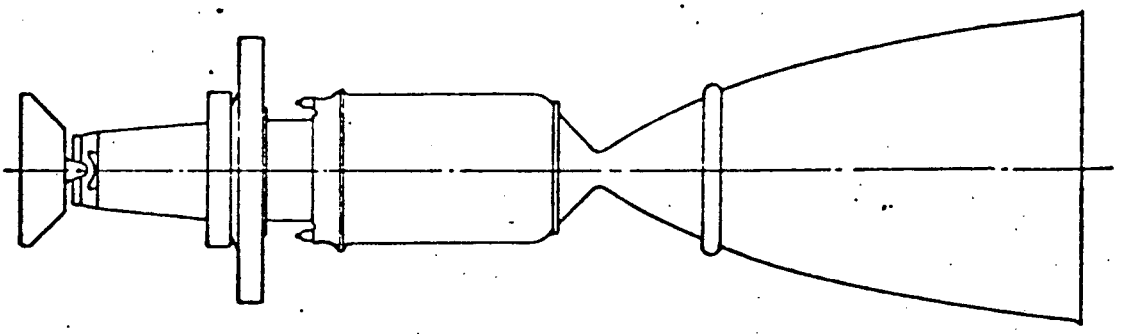


FIGURE 11-8



f = 47.54 Hz

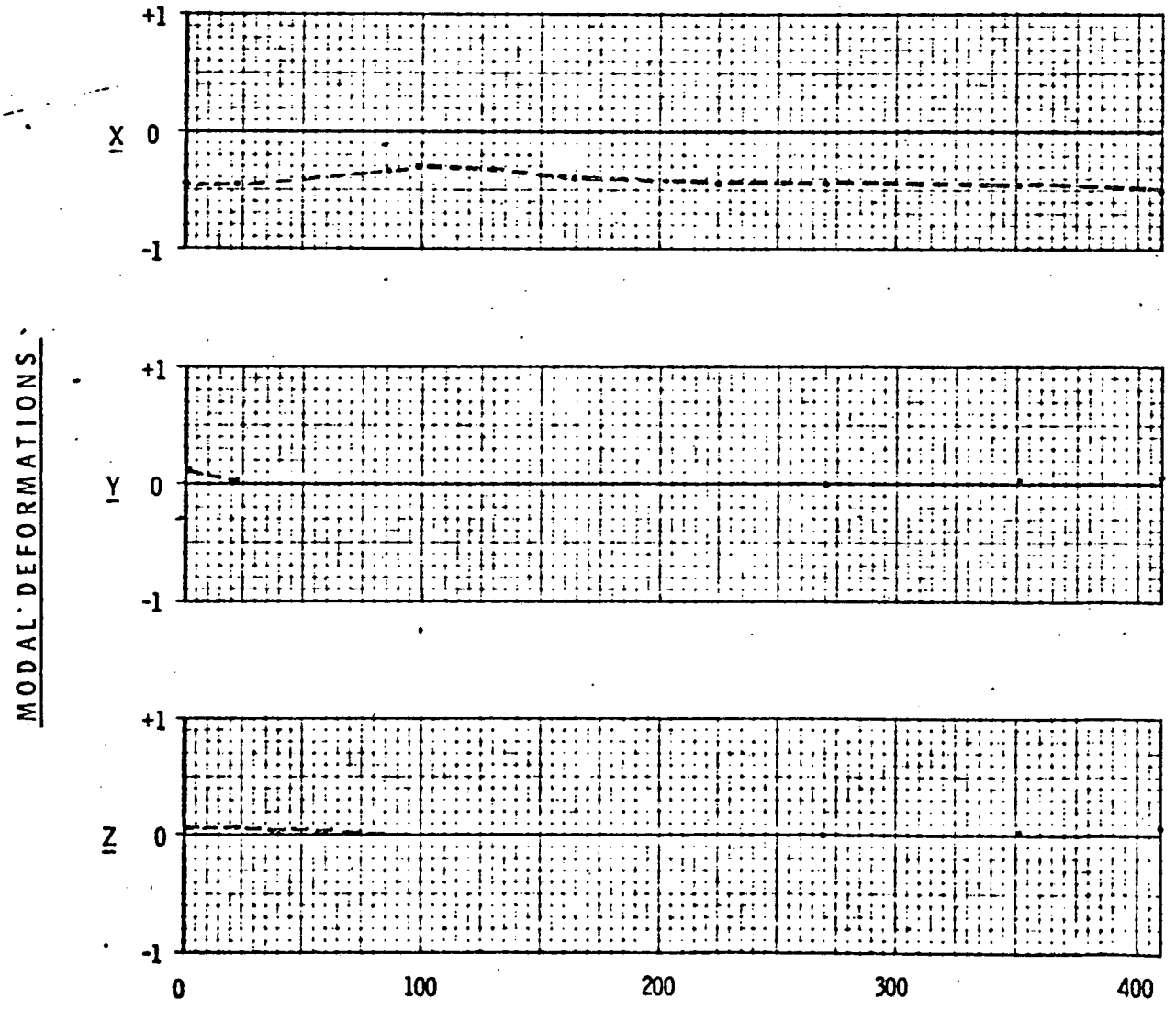
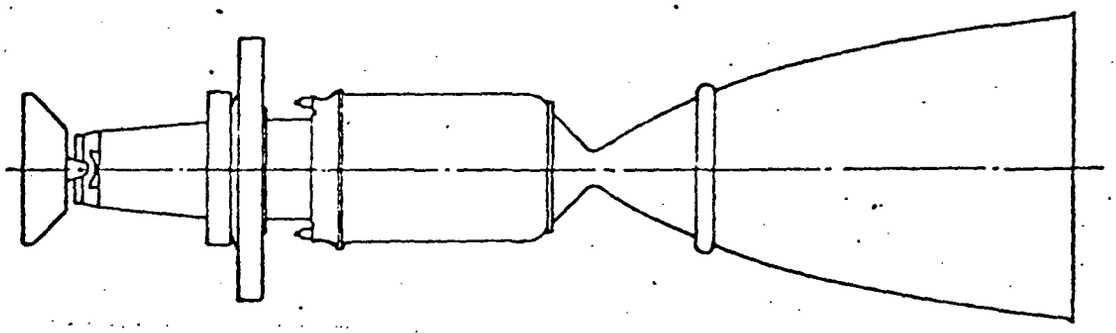


FIGURE 11-9



f = 54.38 Hz

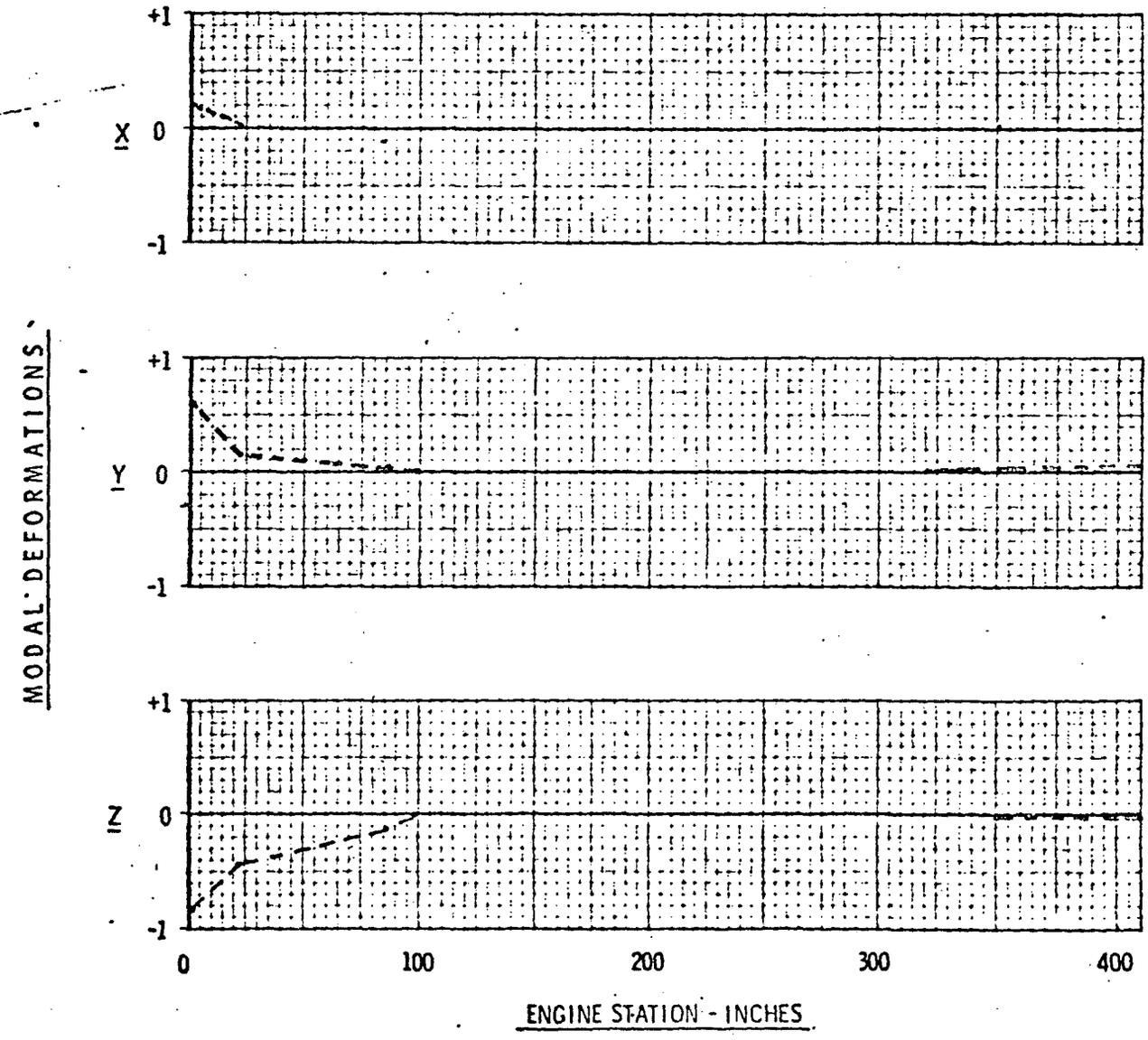
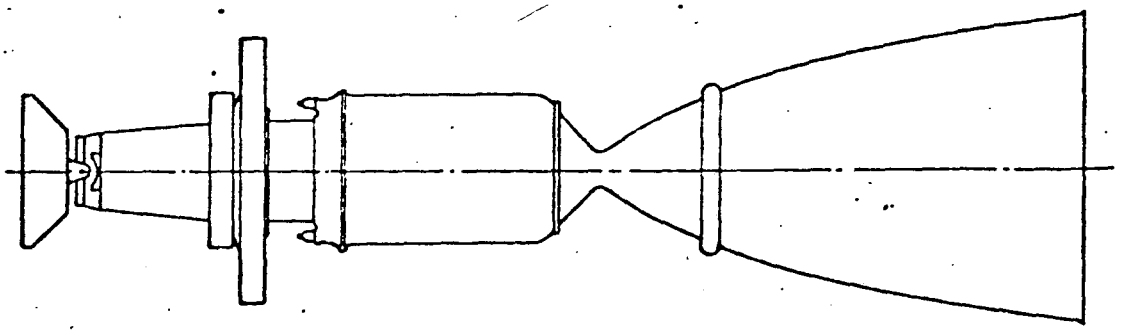


FIGURE 11-10



f = 59.09 Hz

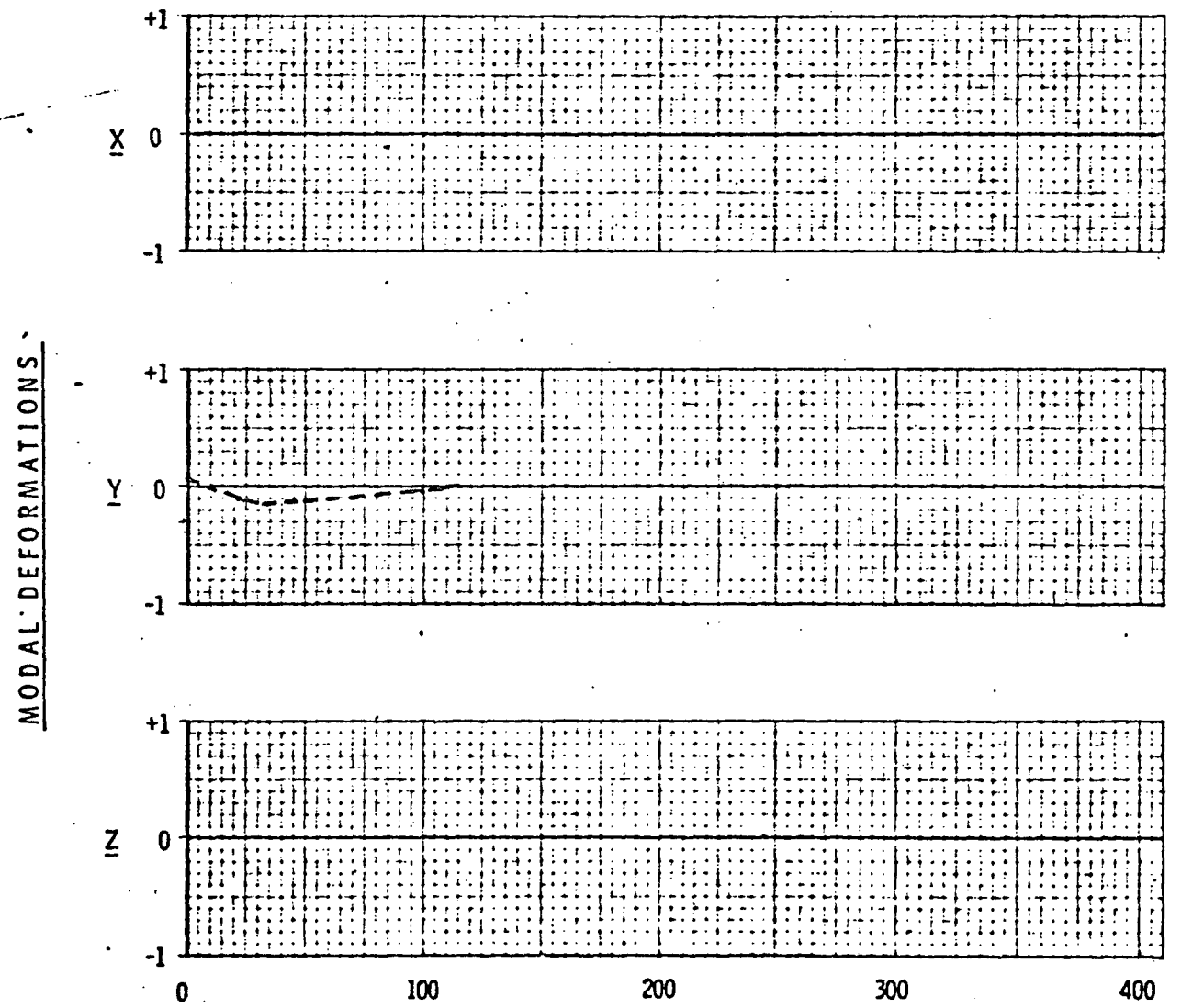
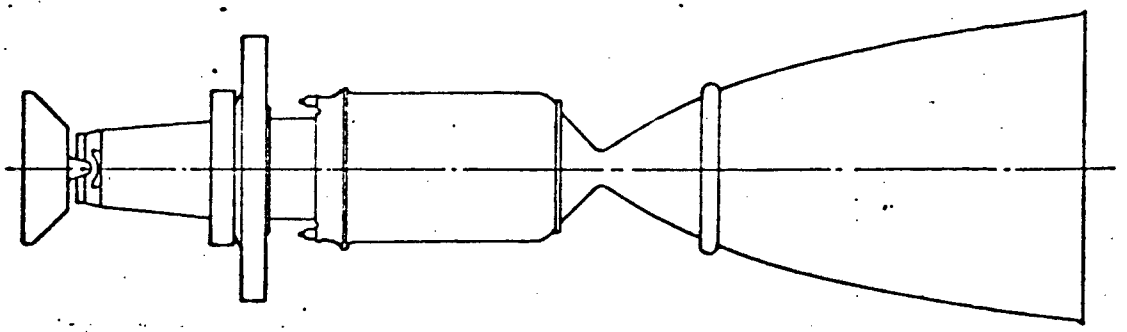


FIGURE 11-11



f = 64.78 Hz

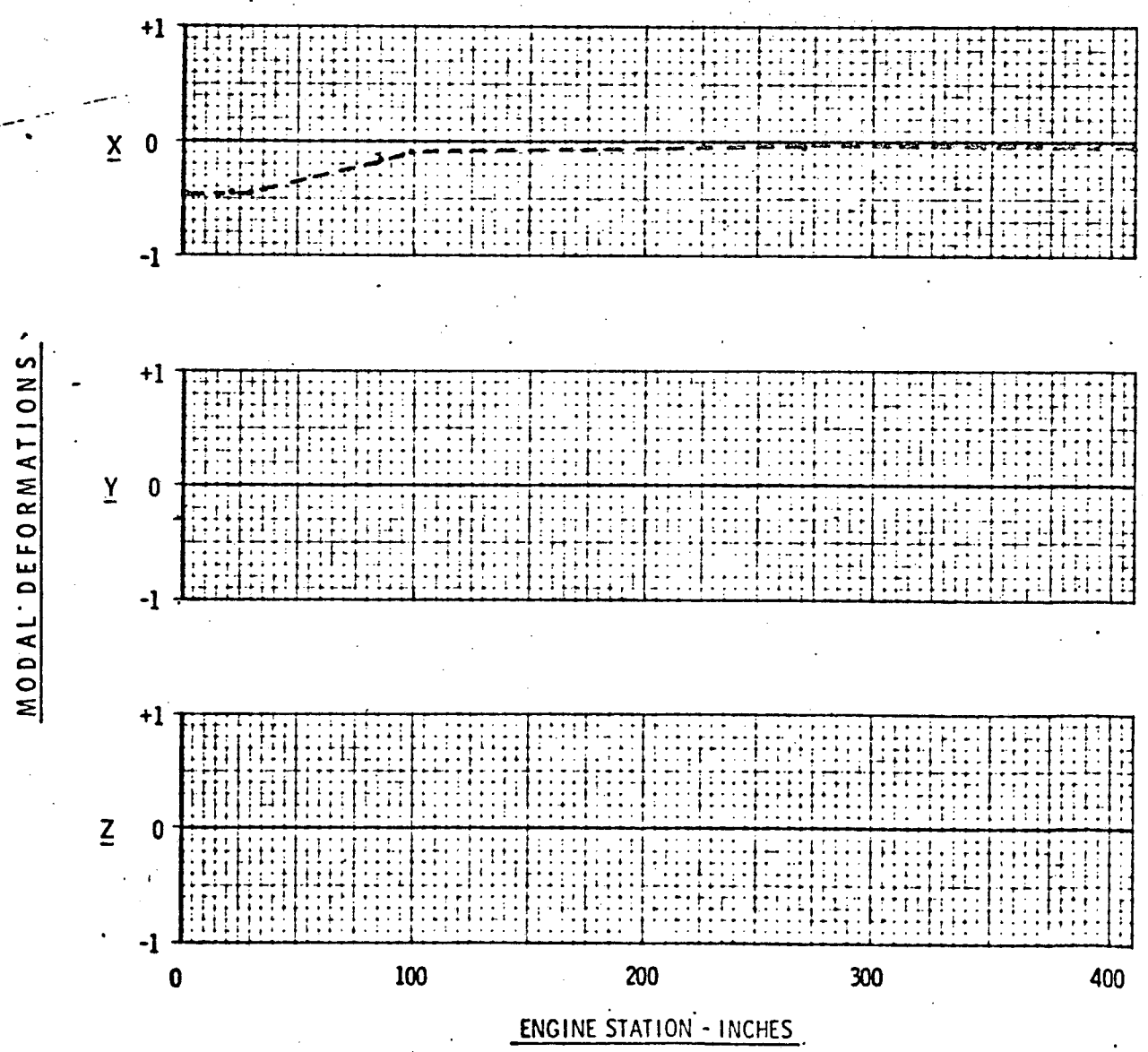


FIGURE 12

NERVA TPA INPUT ACCELERATION SPECTRA

g^2/Hz vs. Hz

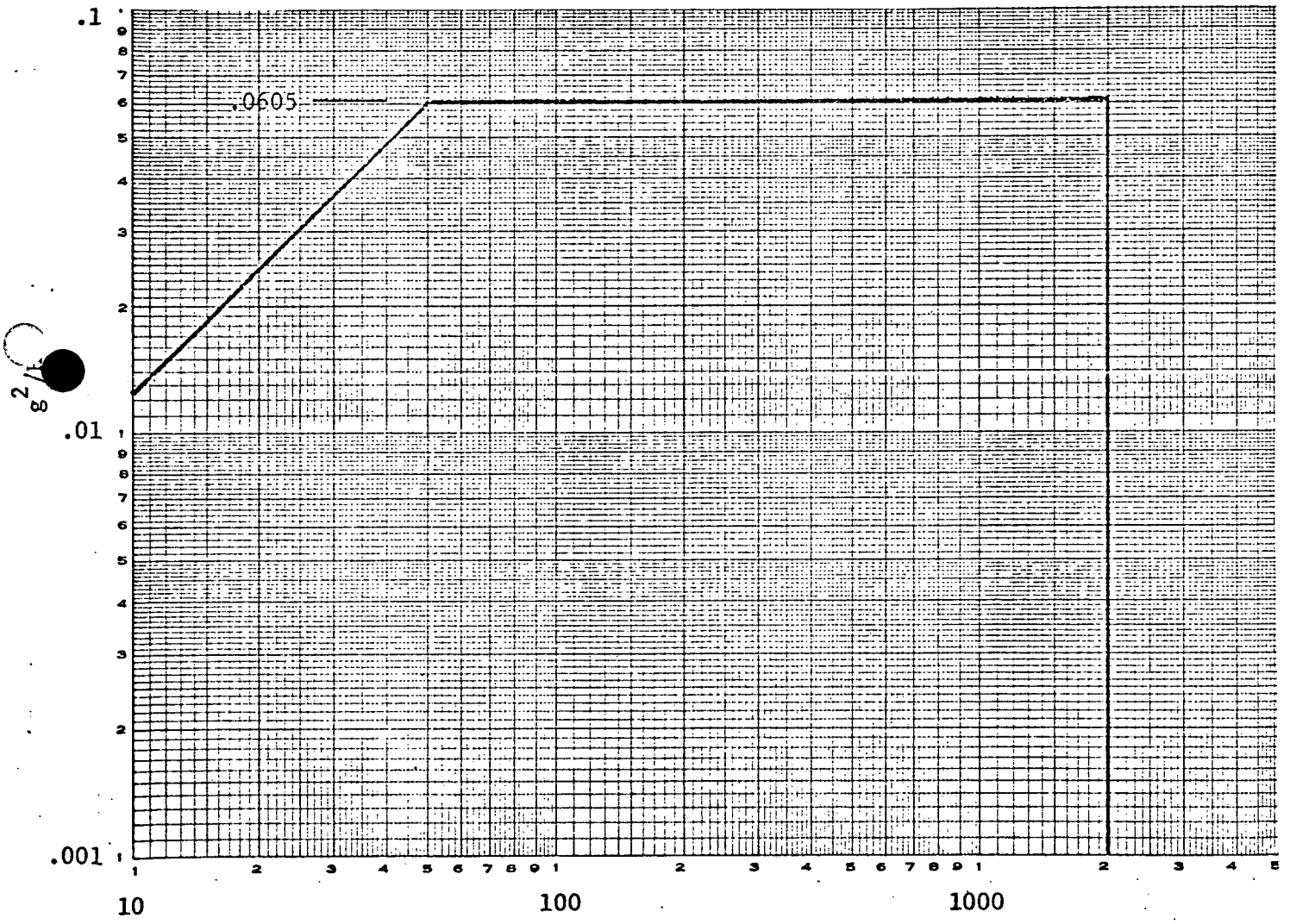


FIGURE 13

NERVA NOZZLE MANIFOLD INPUT ACCELERATION SPECTRA

g^2/Hz vs. Hz

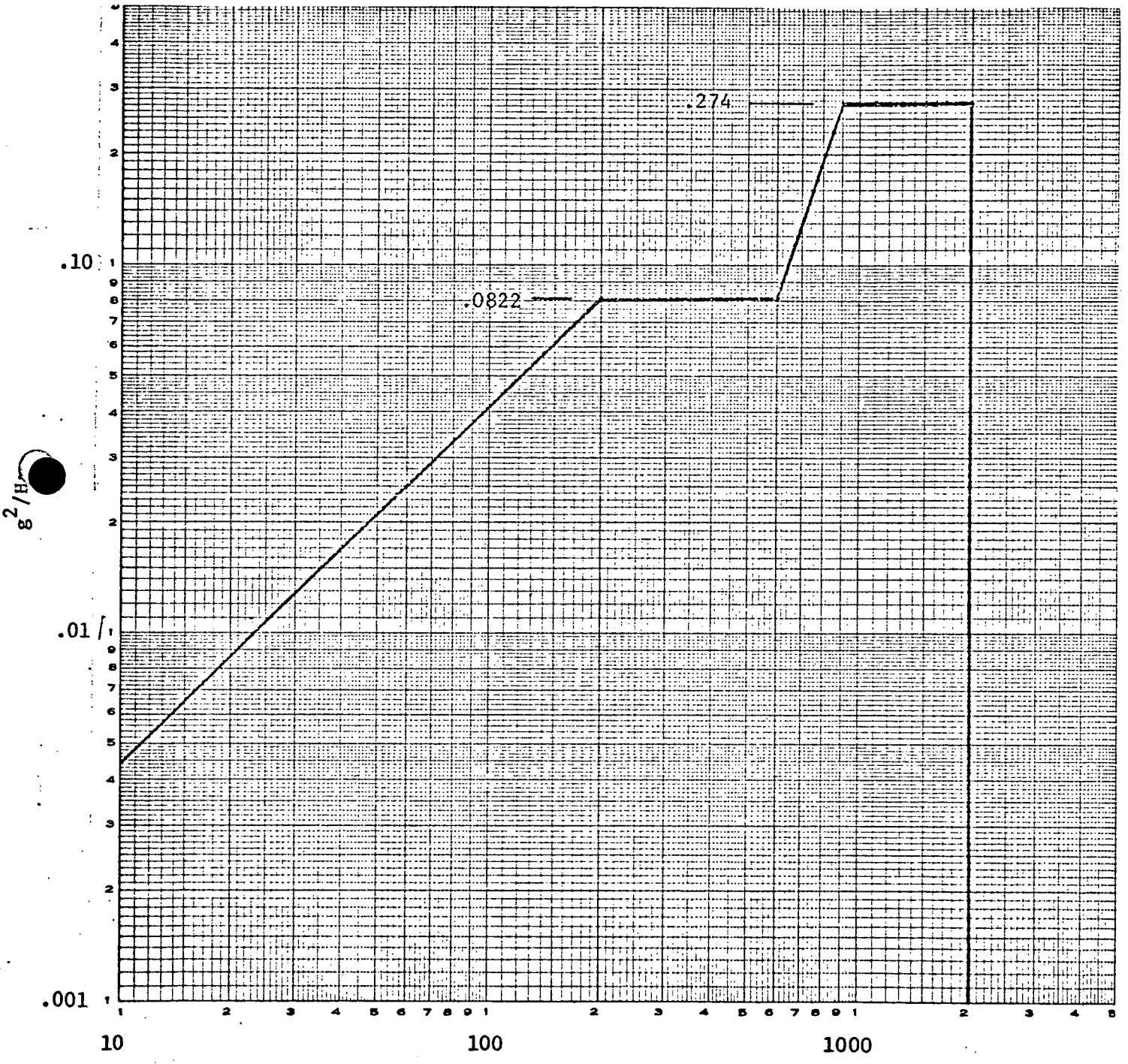
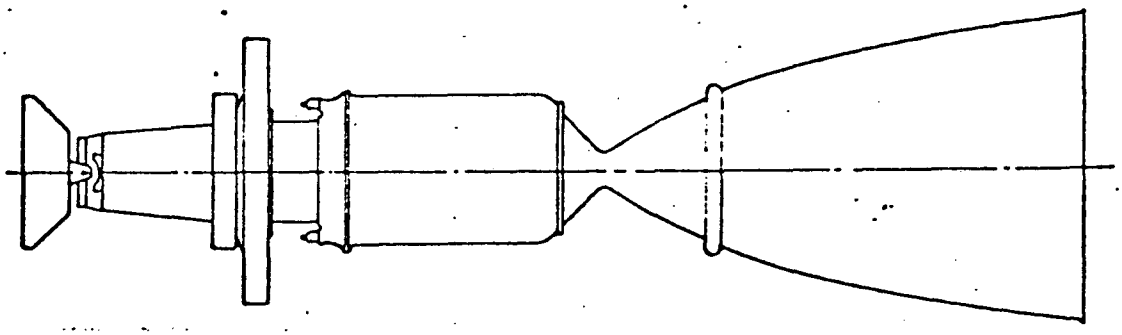


FIGURE 14-1



f = 2.074 Hz

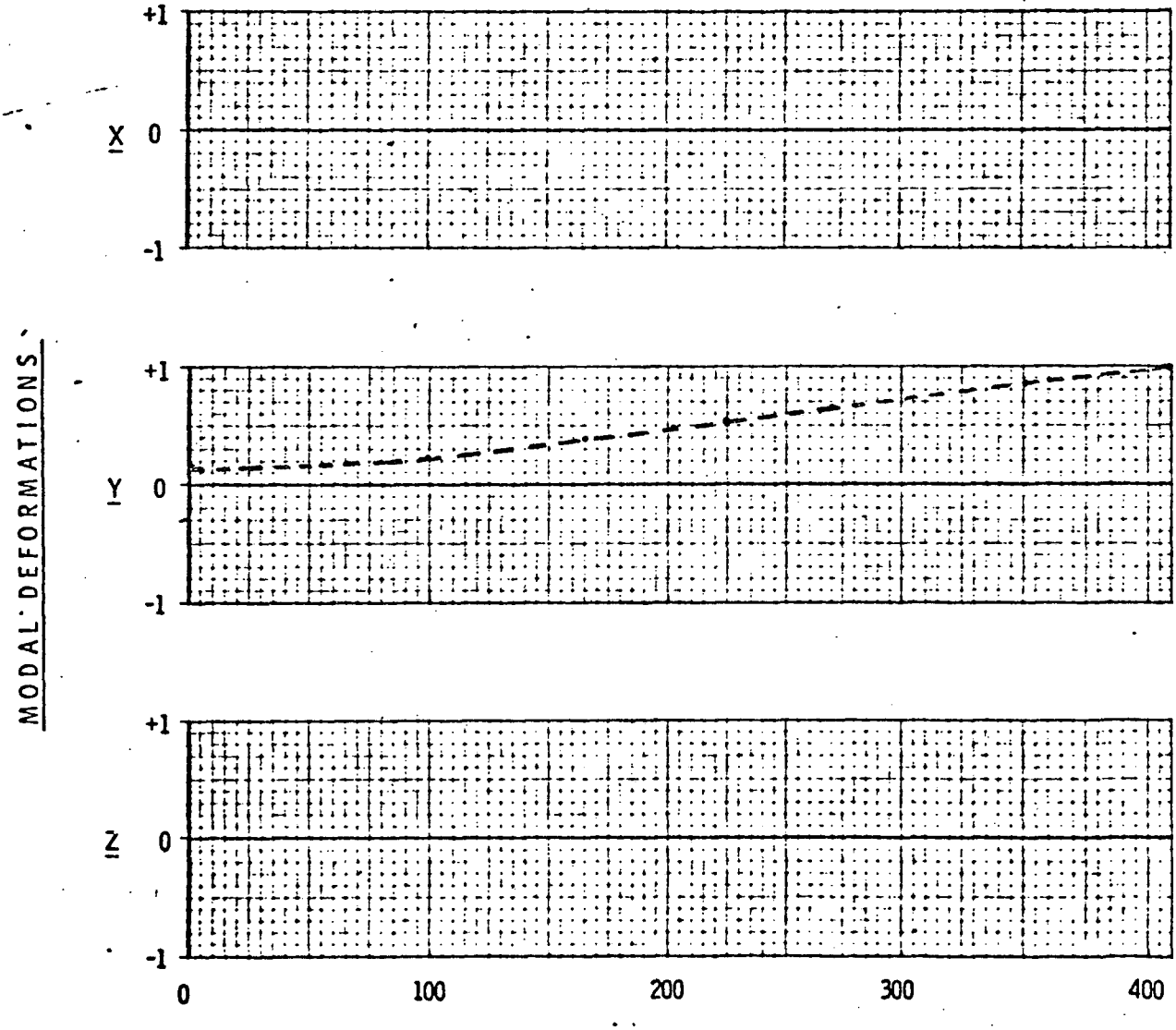
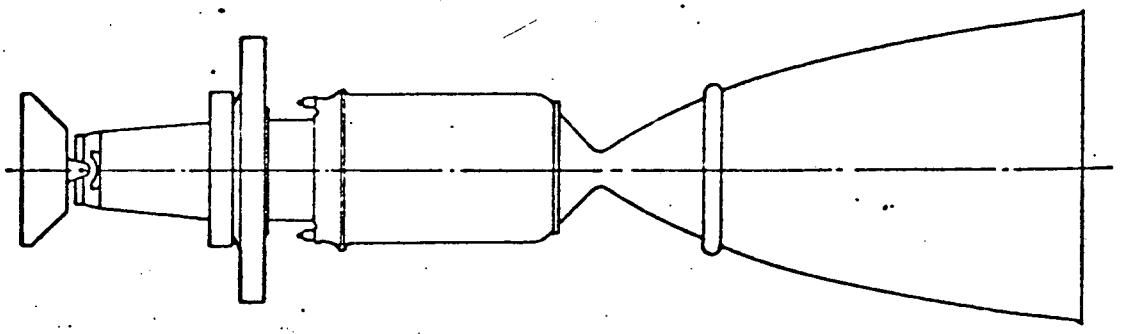


FIGURE 14-2



f = 2.322 Hz

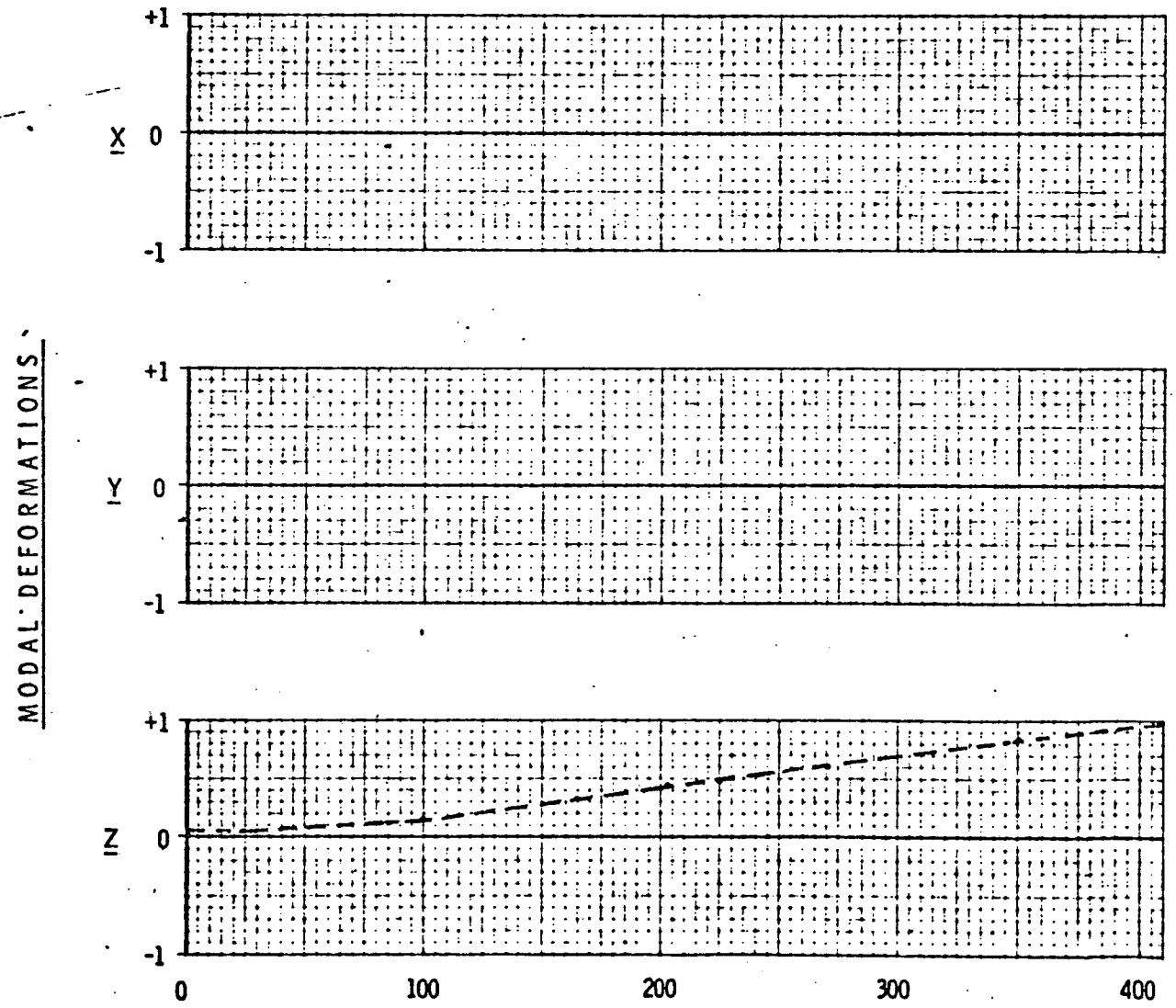
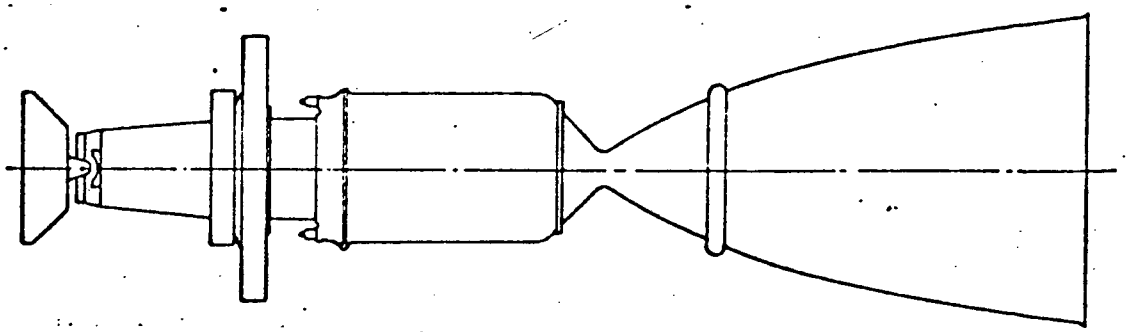


FIGURE 14-3



F = 2.858 Hz

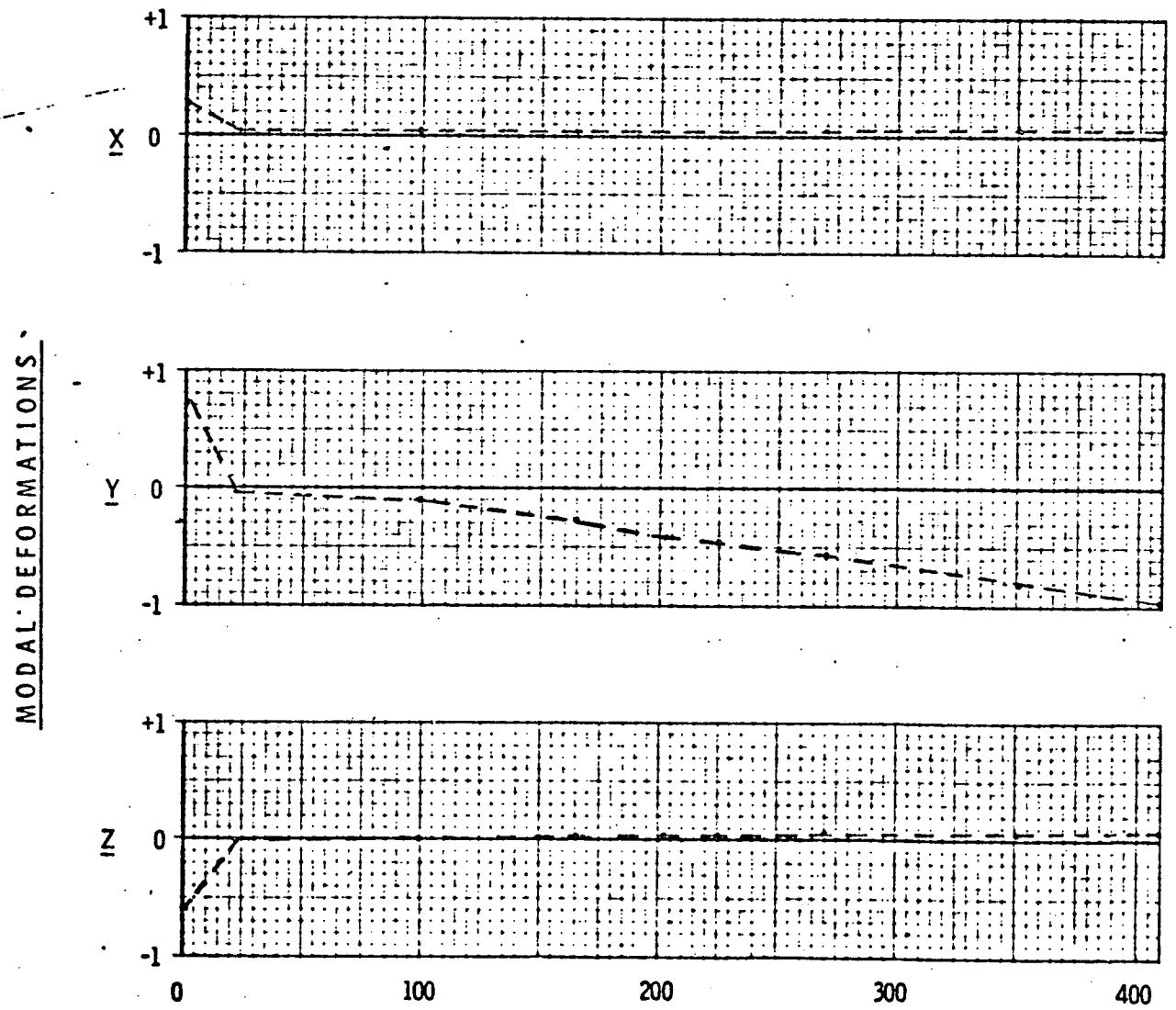
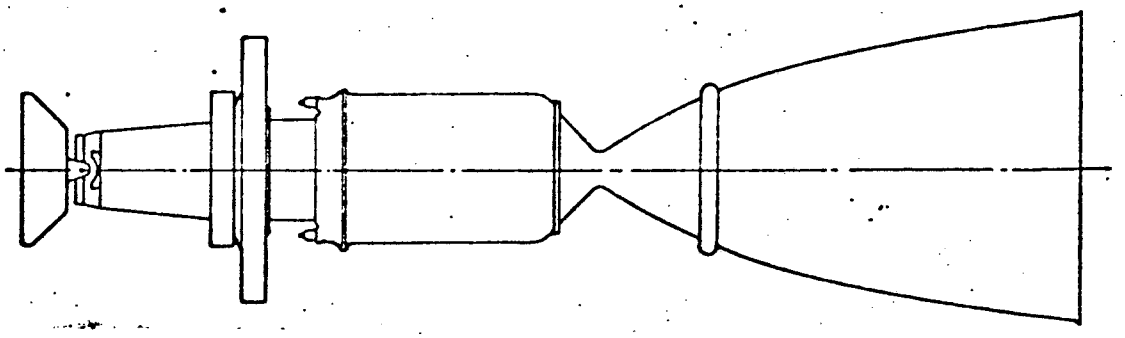


FIGURE 14-4



f = 6.897 Hz

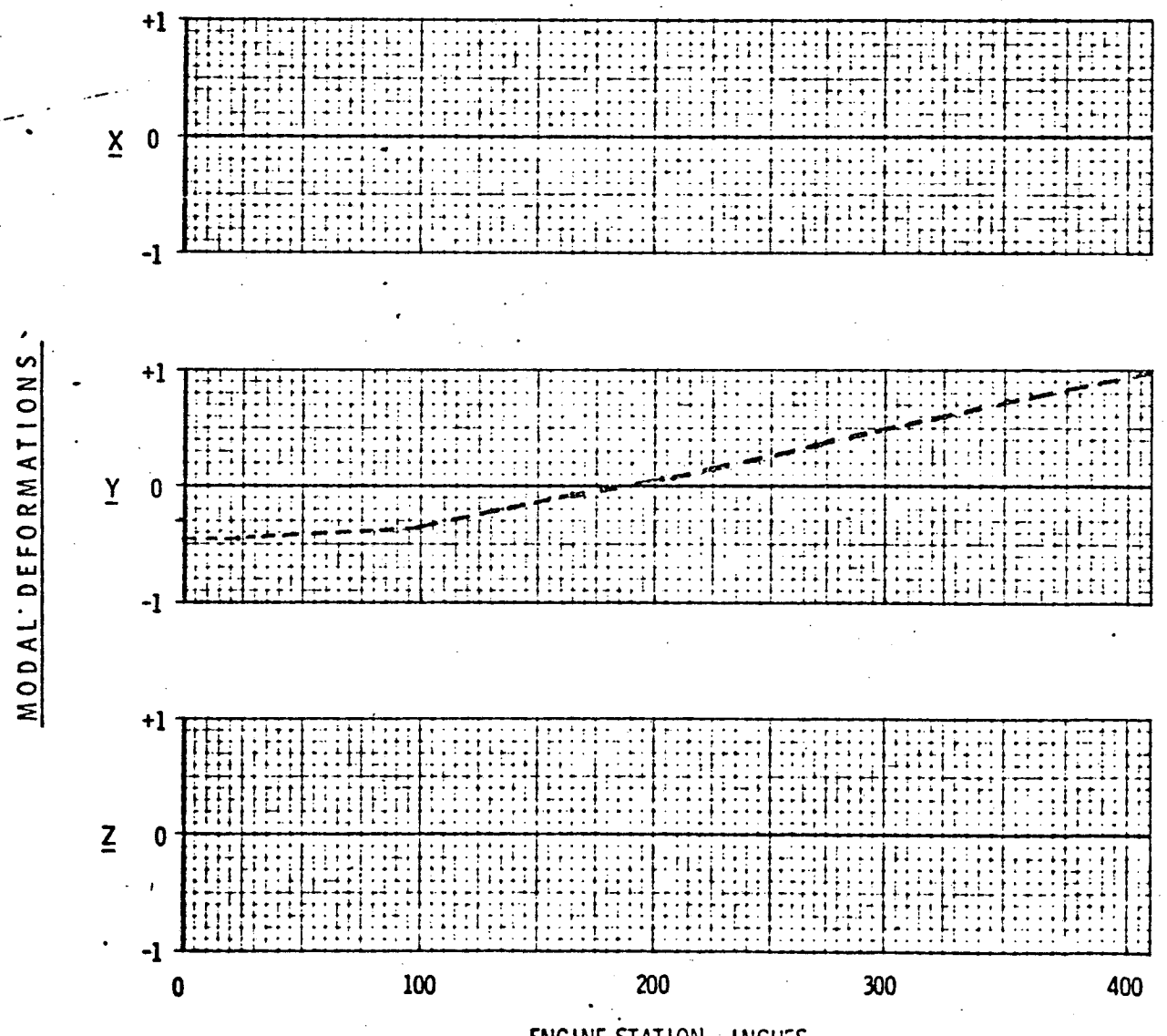
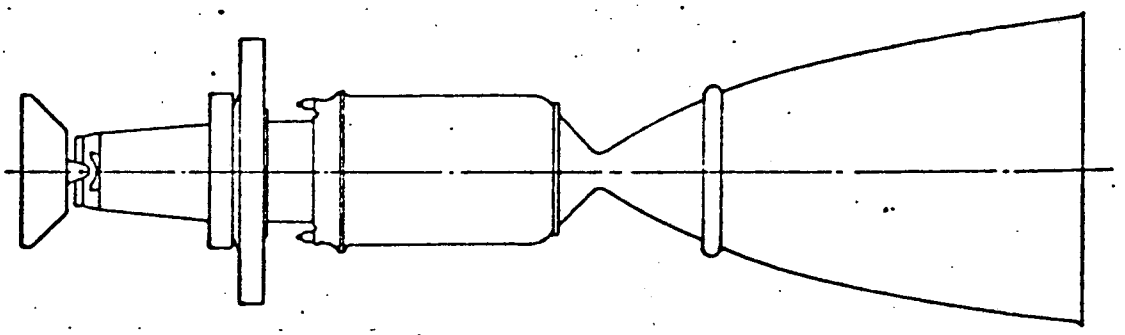


FIGURE 14-5



f = 8.457 Hz

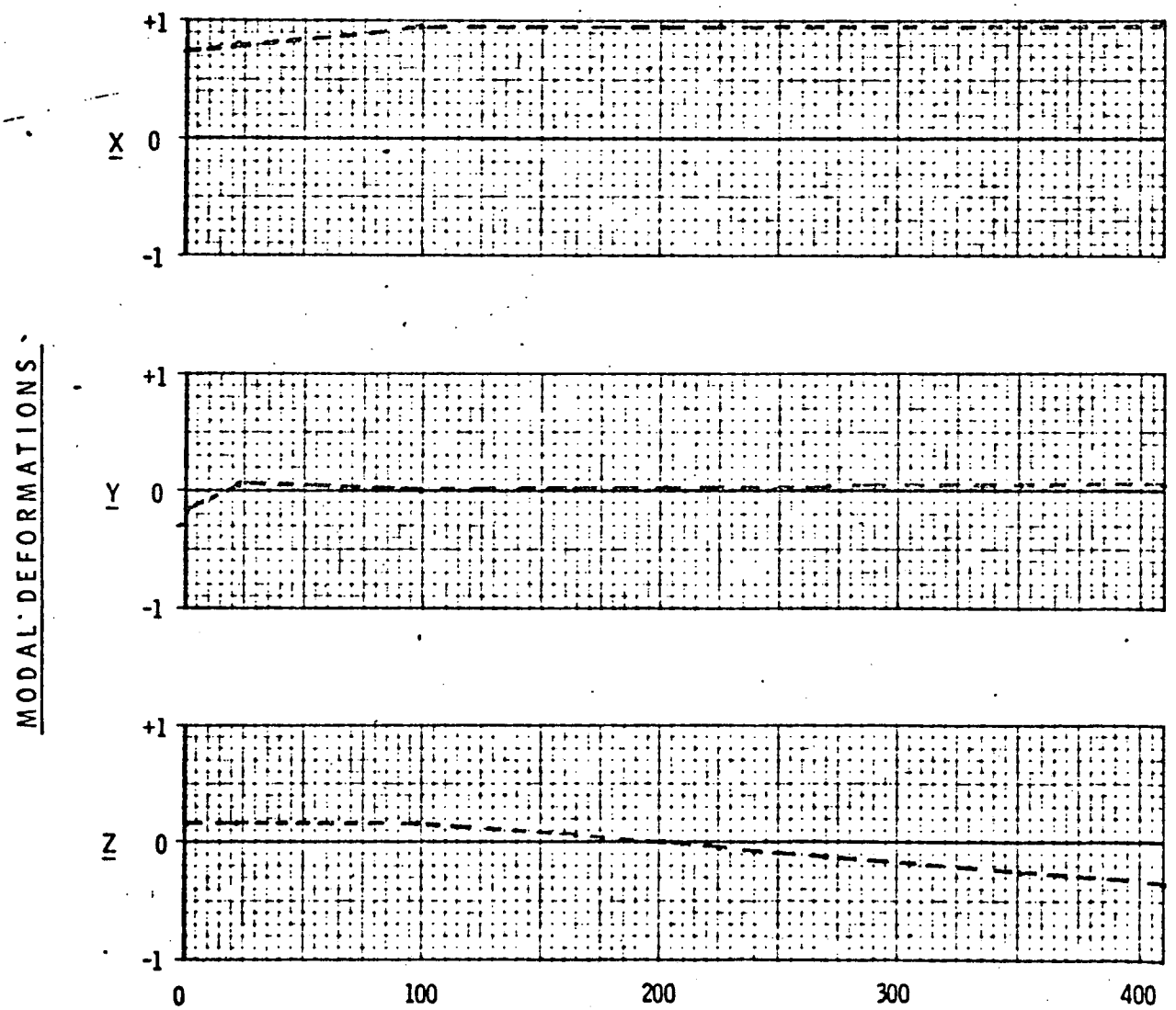
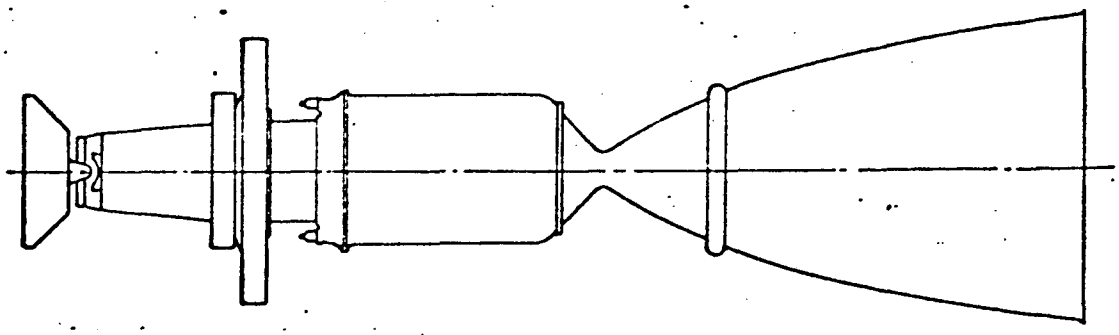


FIGURE 14-6



f = 9.561 Hz

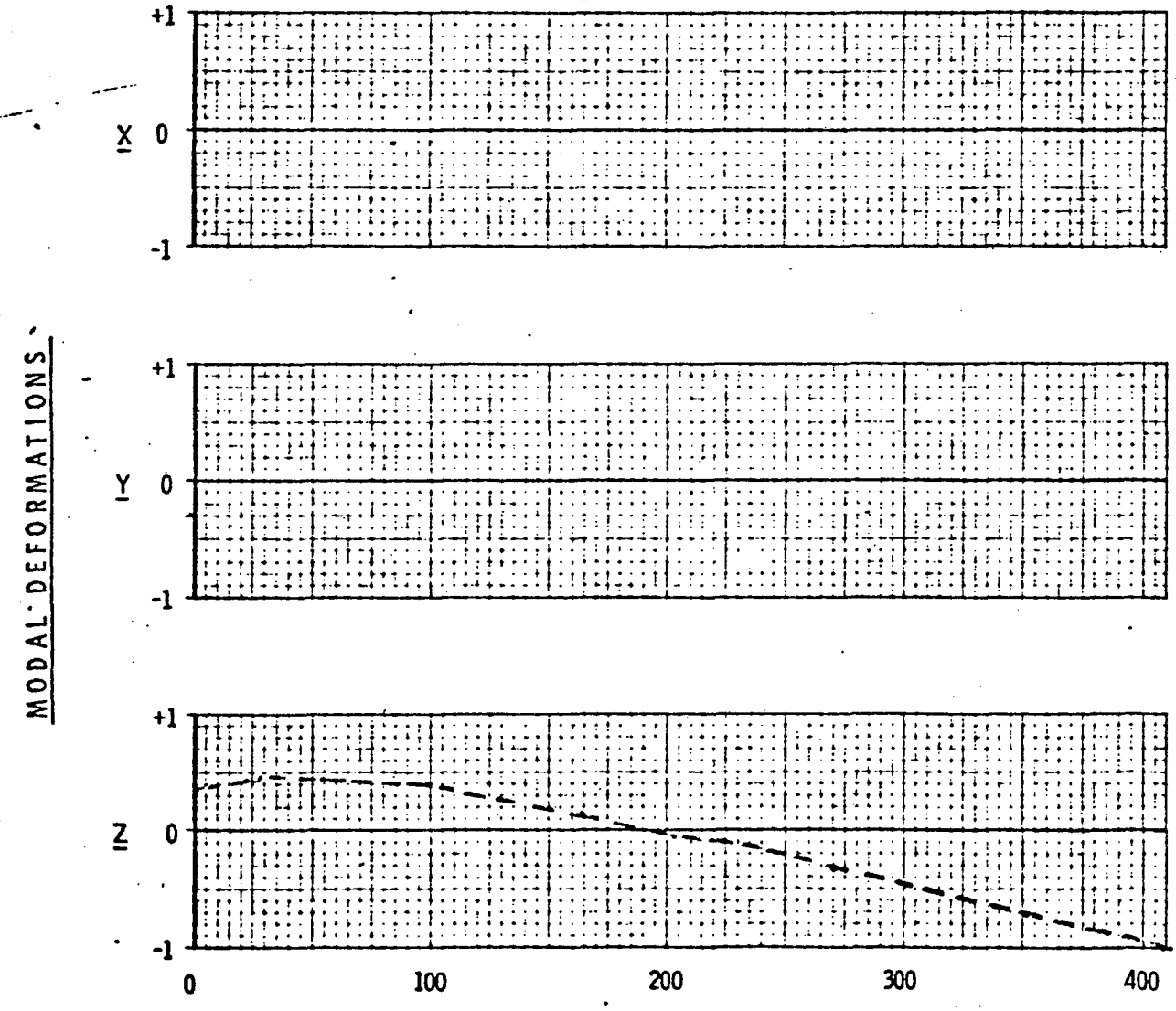
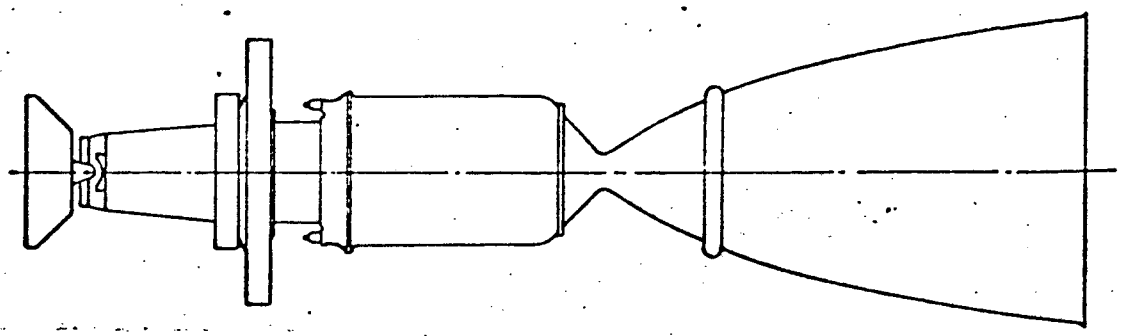


FIGURE 14-7



f = 27.076 Hz

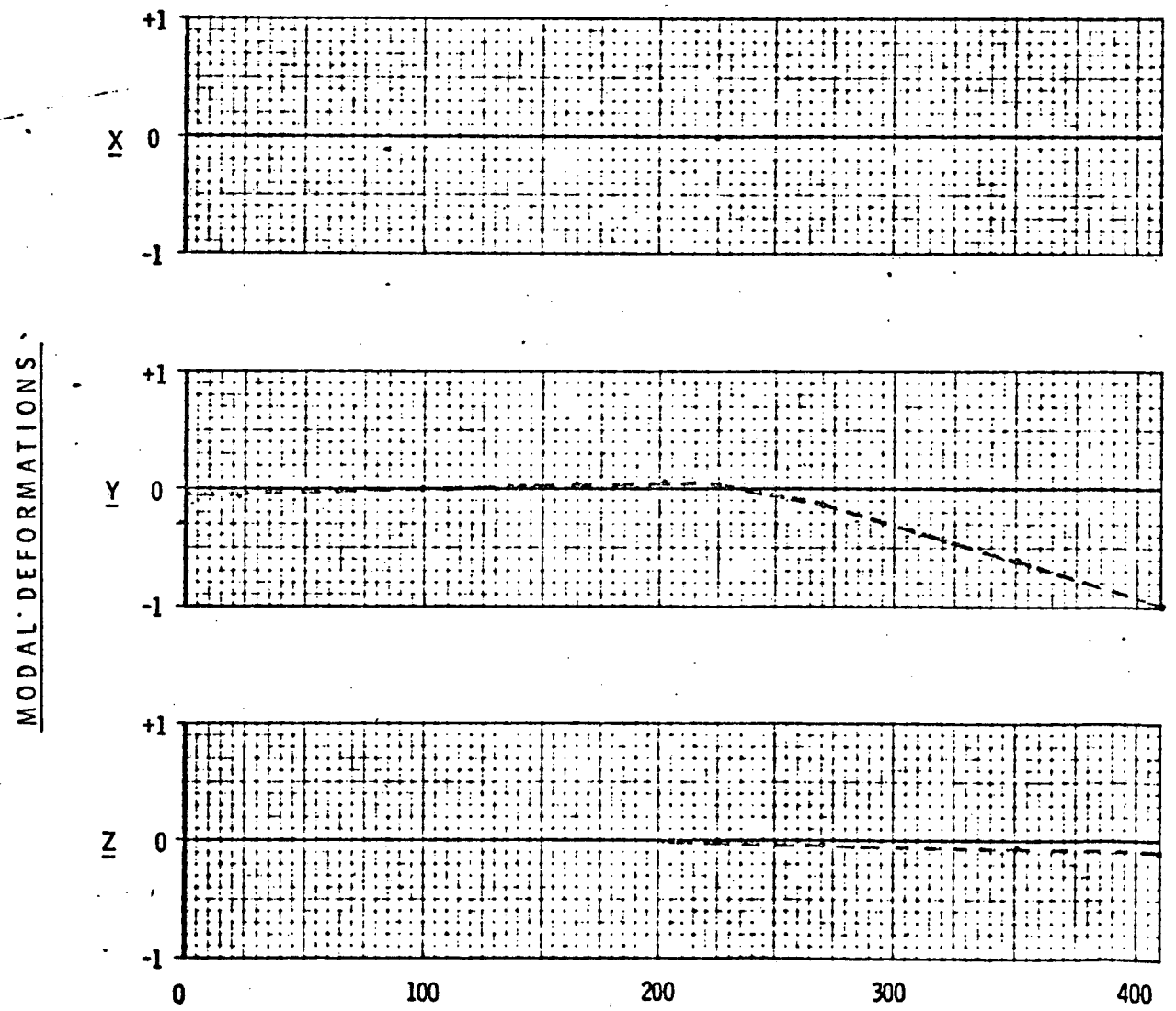
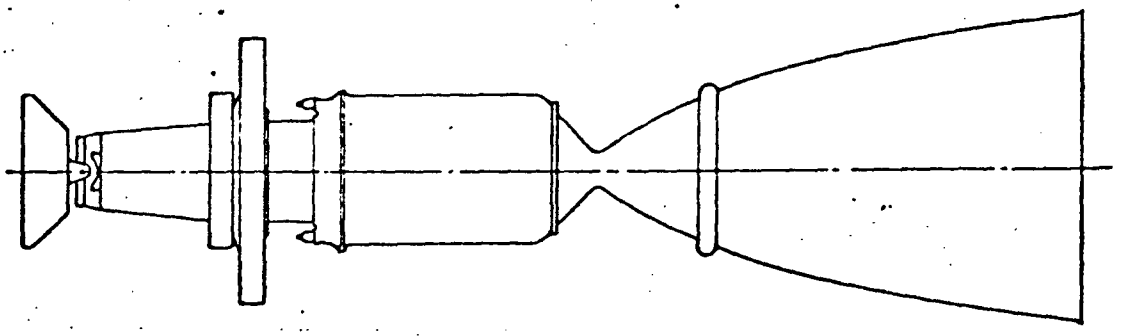


FIGURE 14-8



f = 27.422 Hz

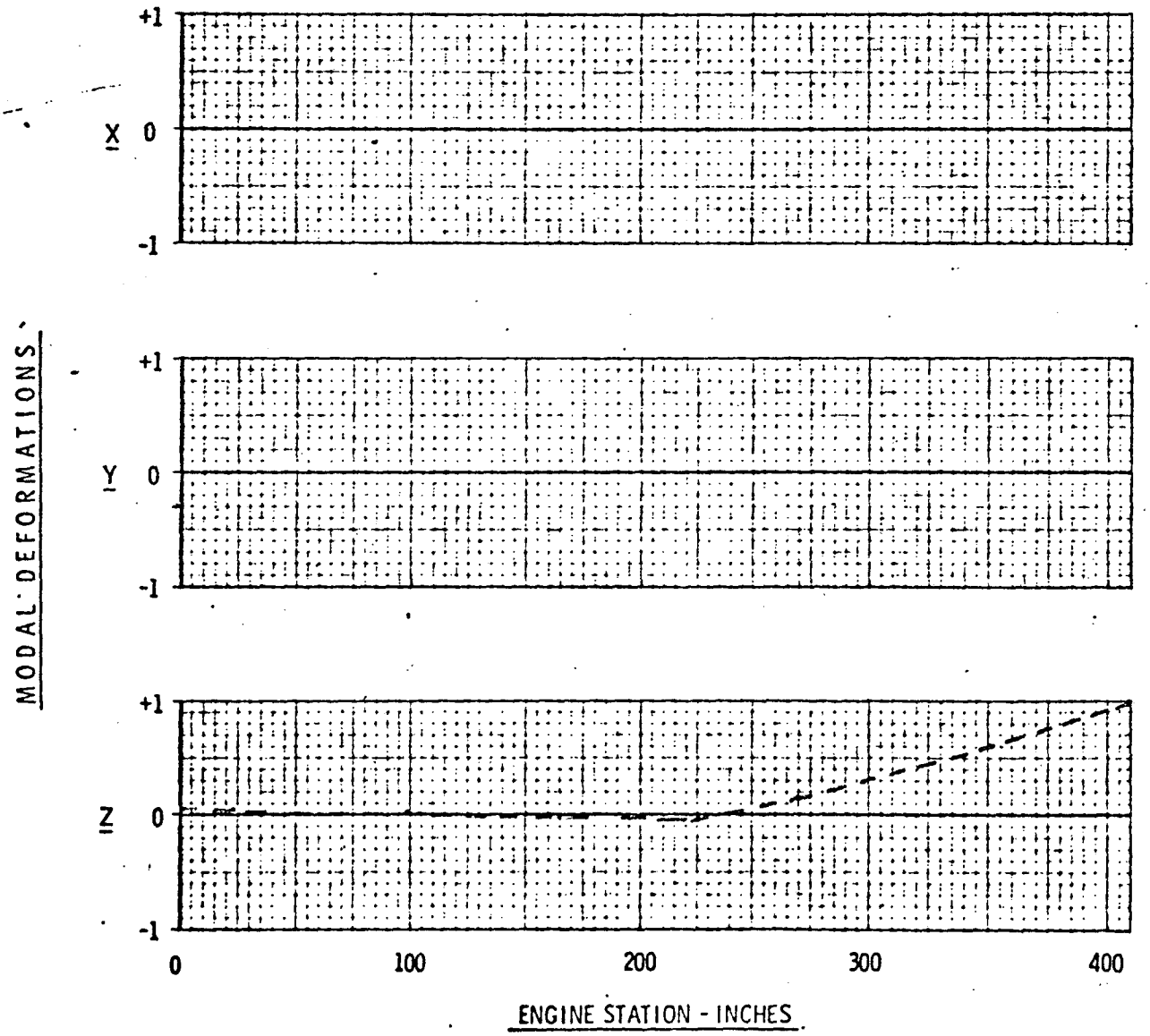
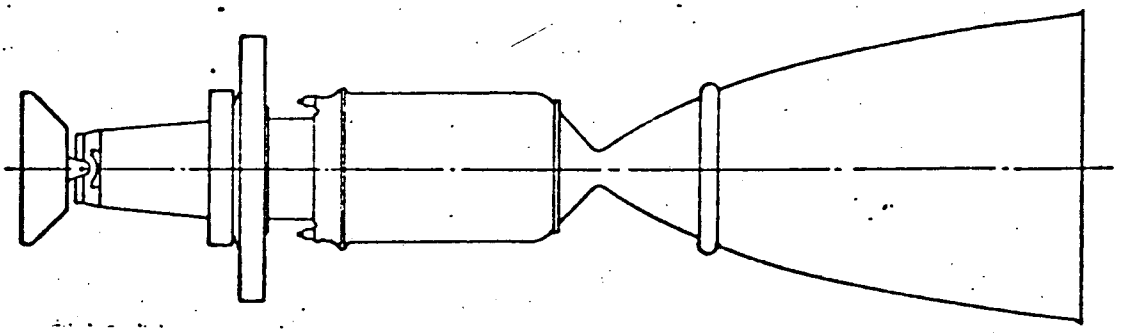


FIGURE 14-9



f = 33.507 Hz

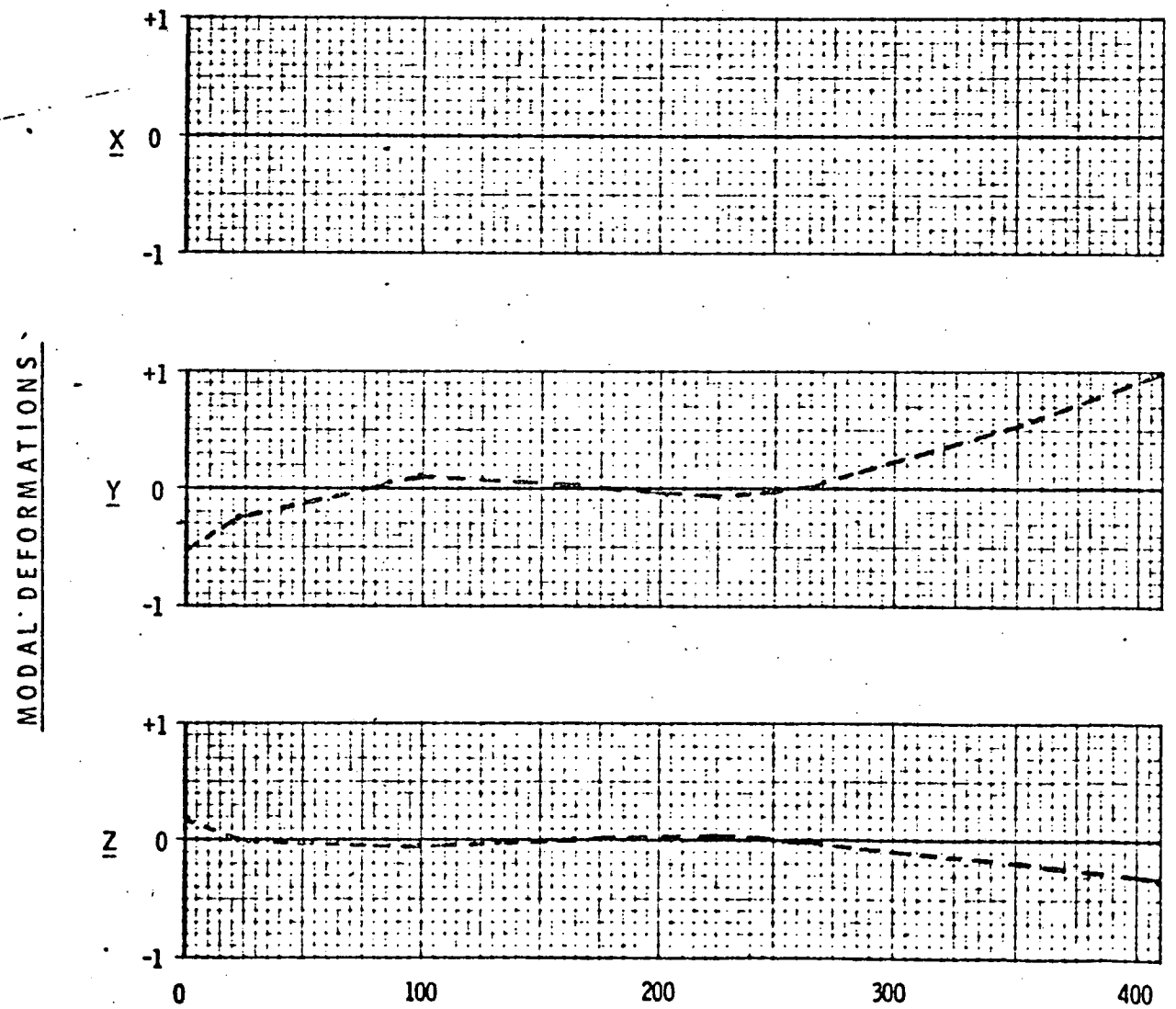
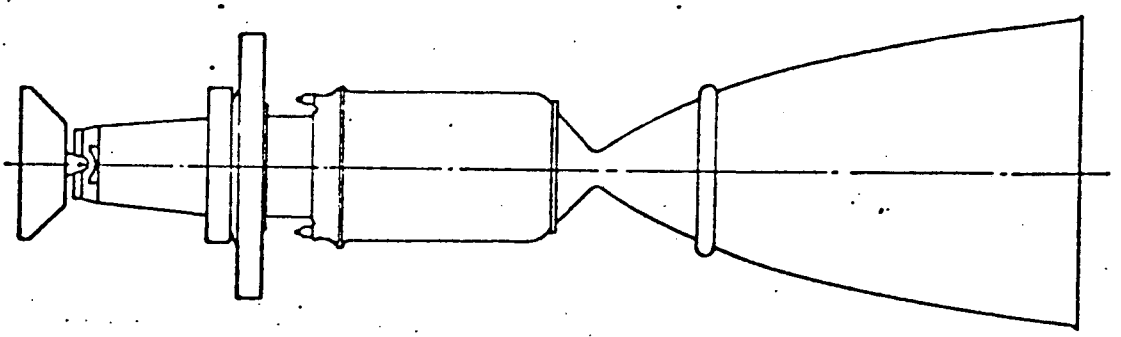


FIGURE 14-10



f = 34.877 Hz

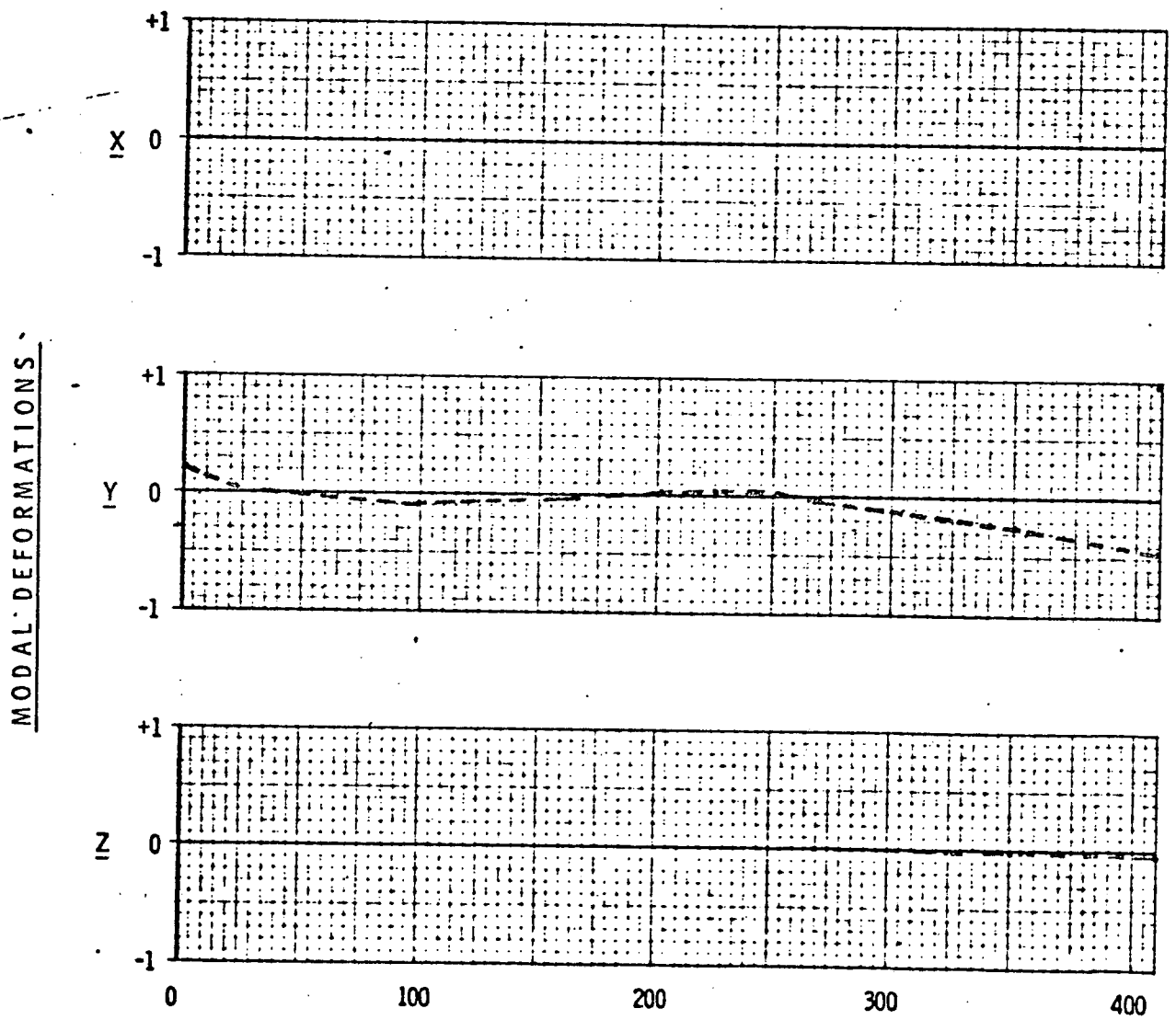
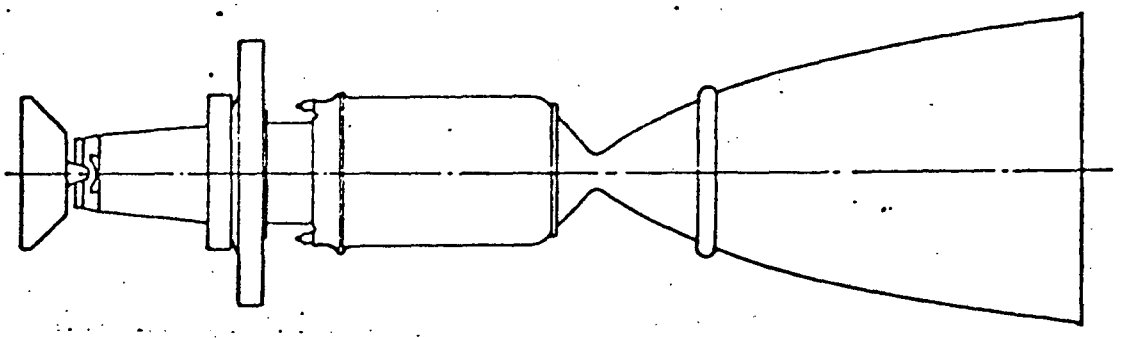


FIGURE 14-11



f = 43.085 Hz

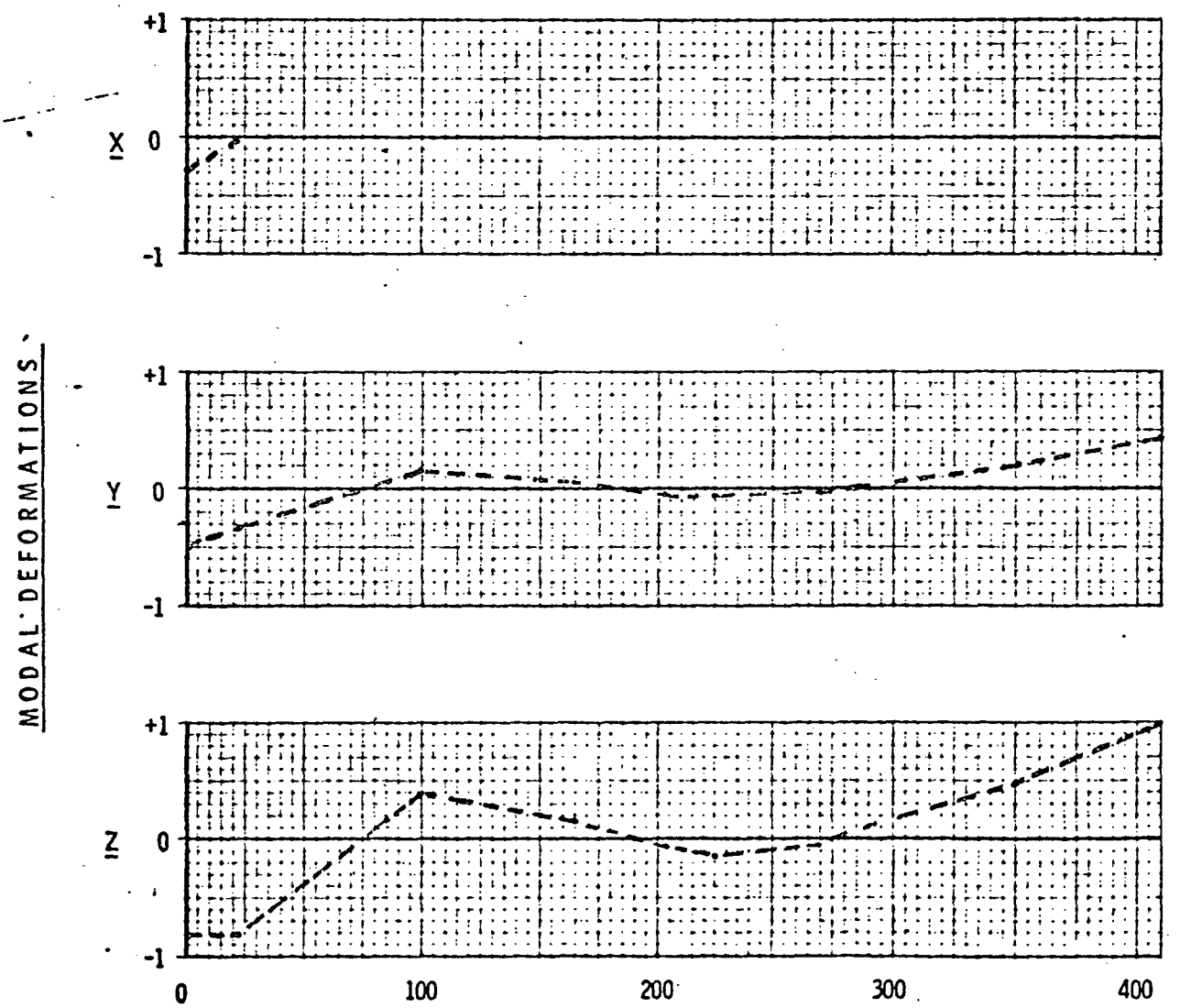
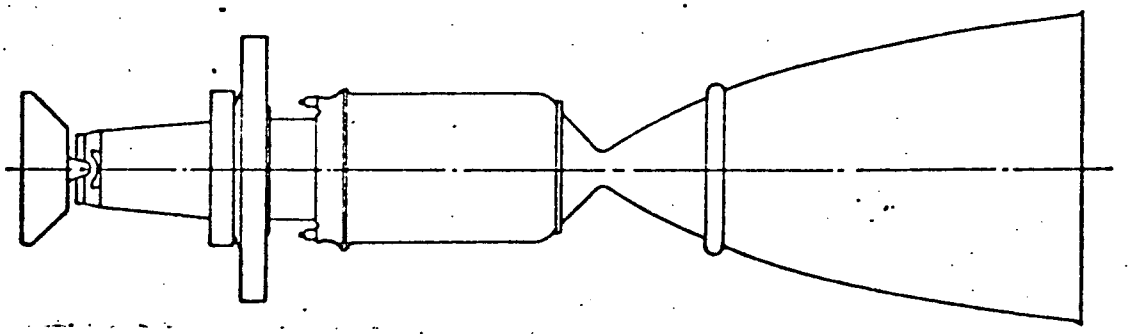


FIGURE 14-12



f = 43.482 Hz

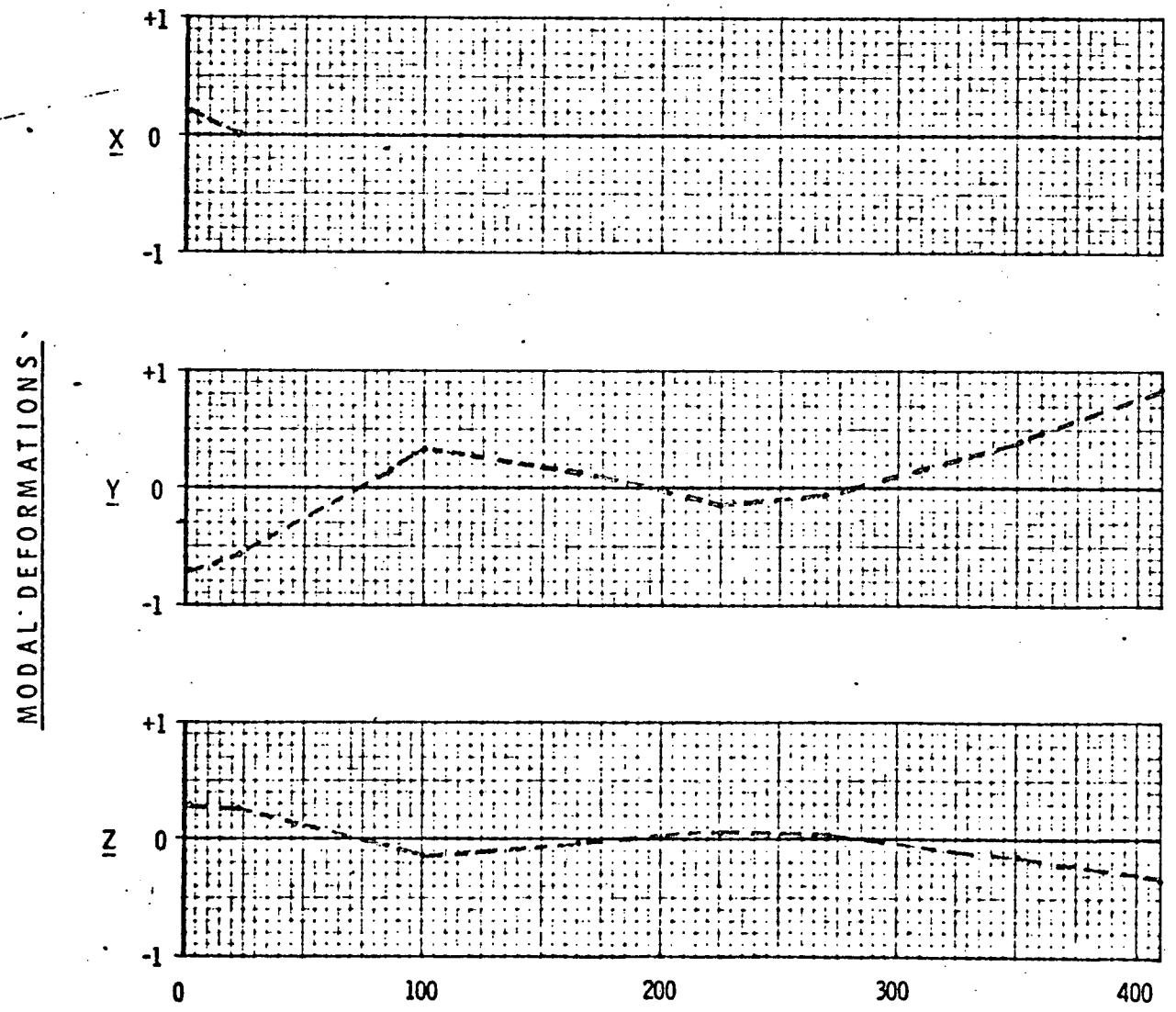
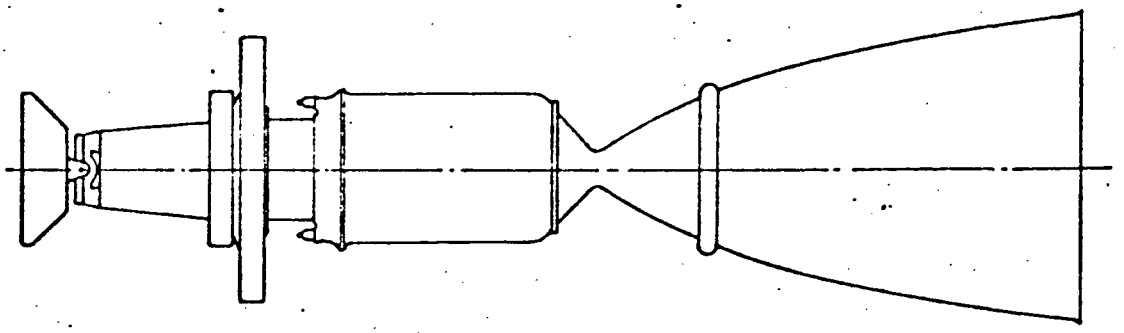


FIGURE 14-13



f = 57.358 Hz

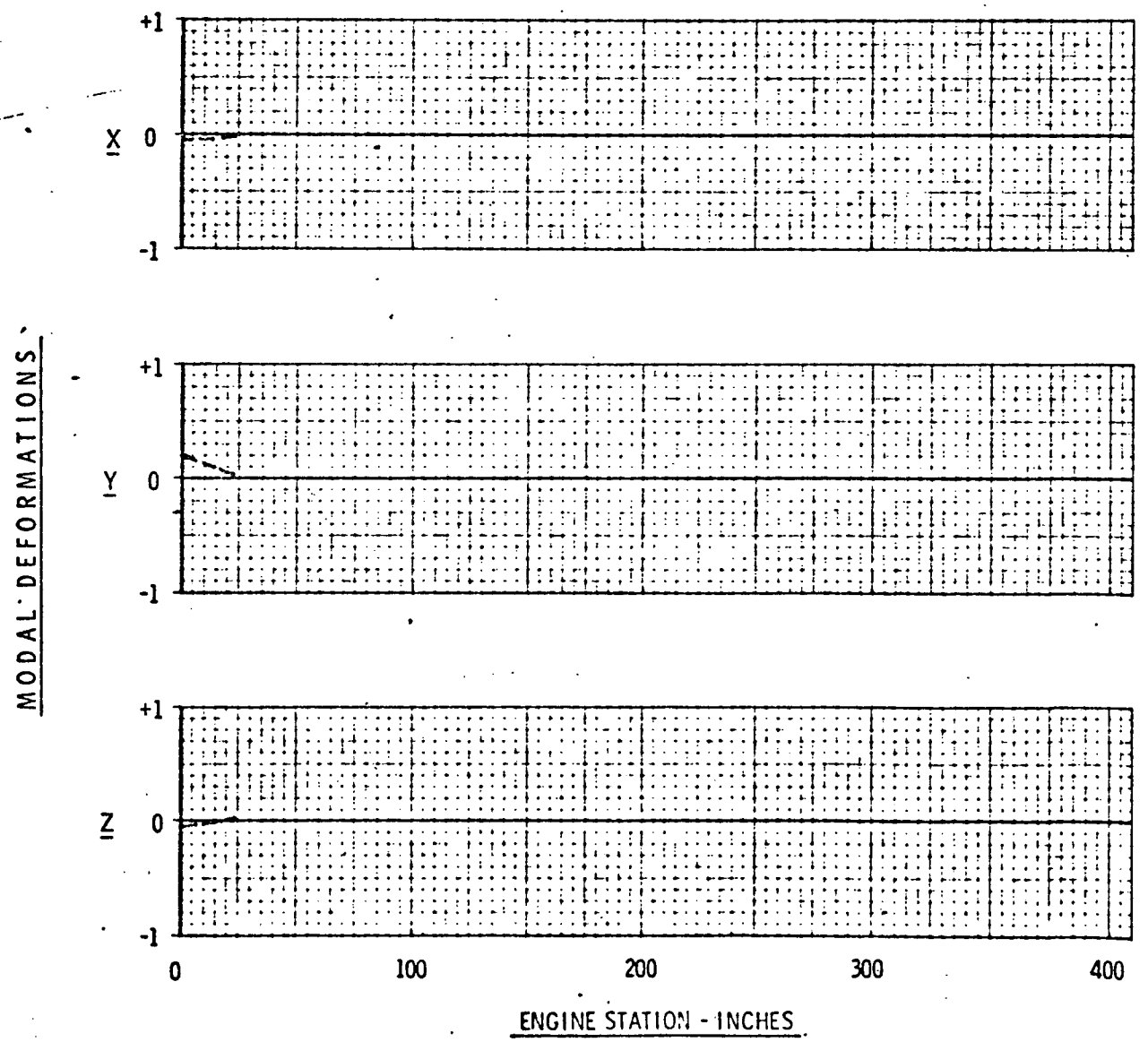
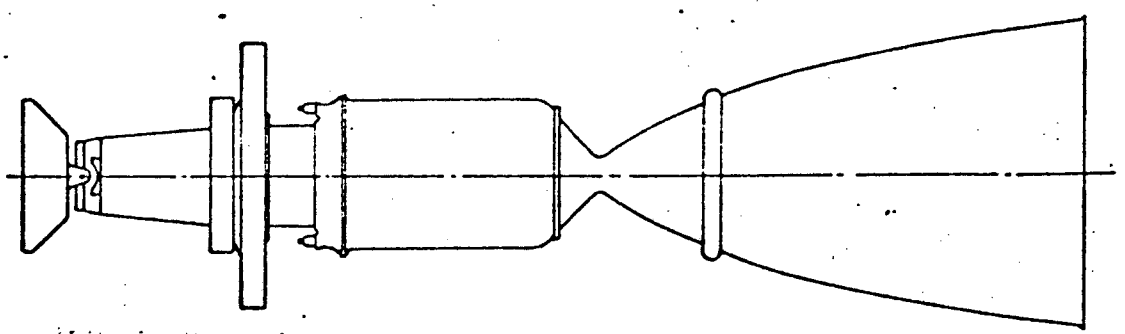


FIGURE 14-14



f = 59.147 Hz

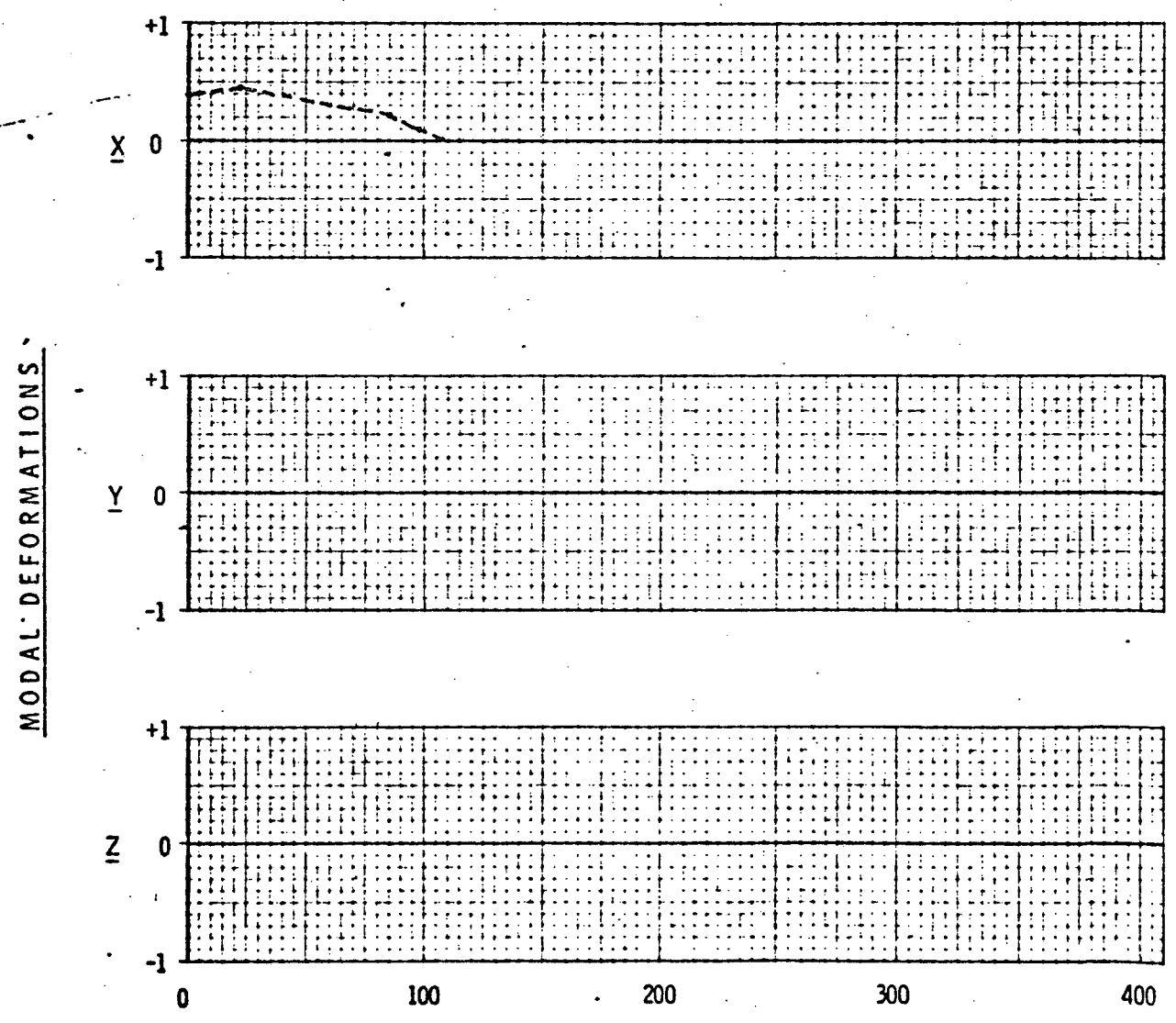
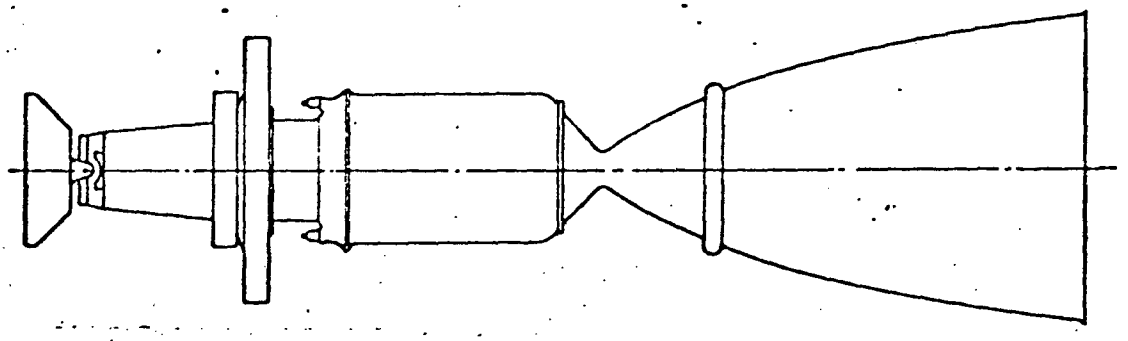


FIGURE 15-1



f = 2.162 Hz

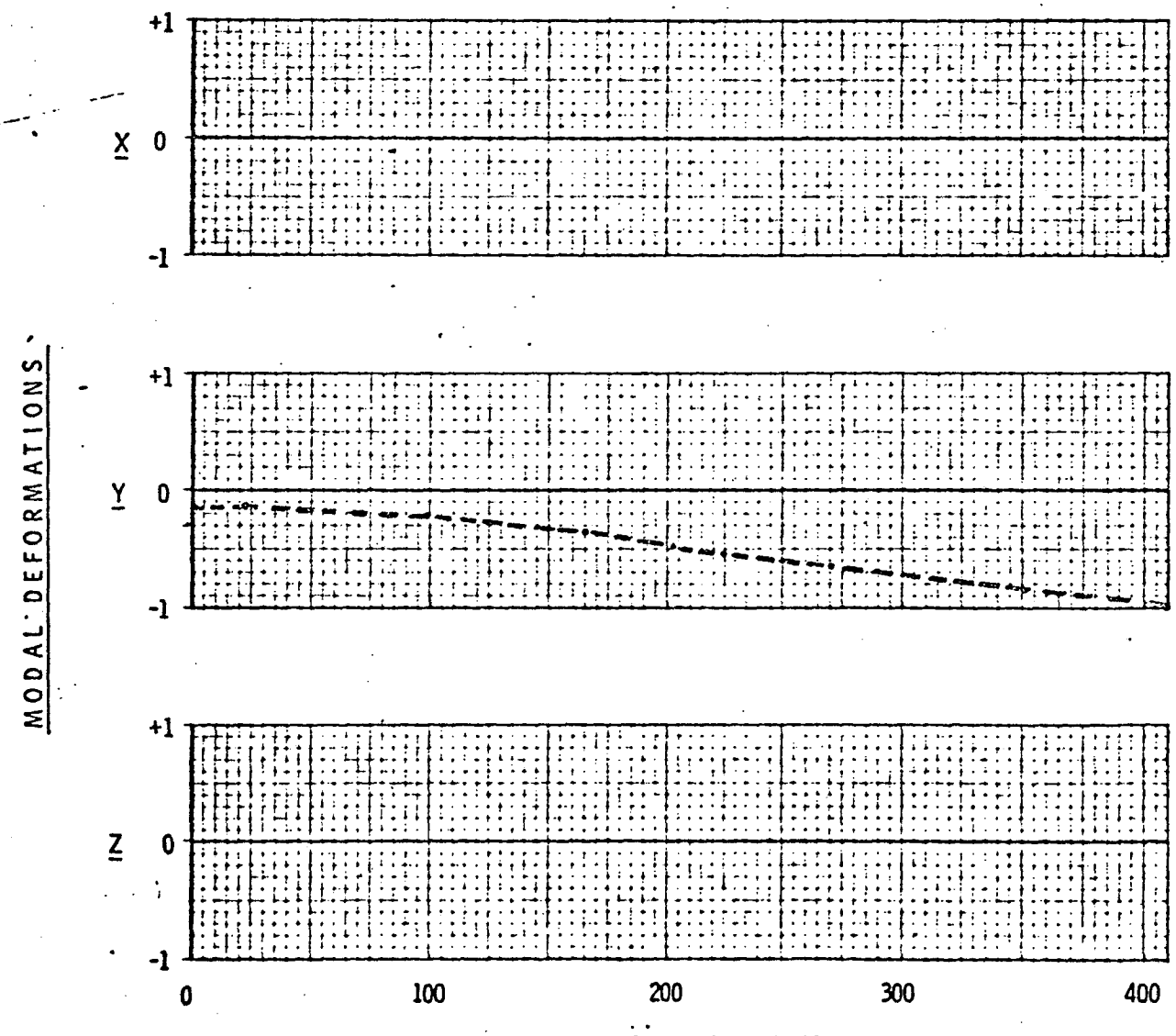
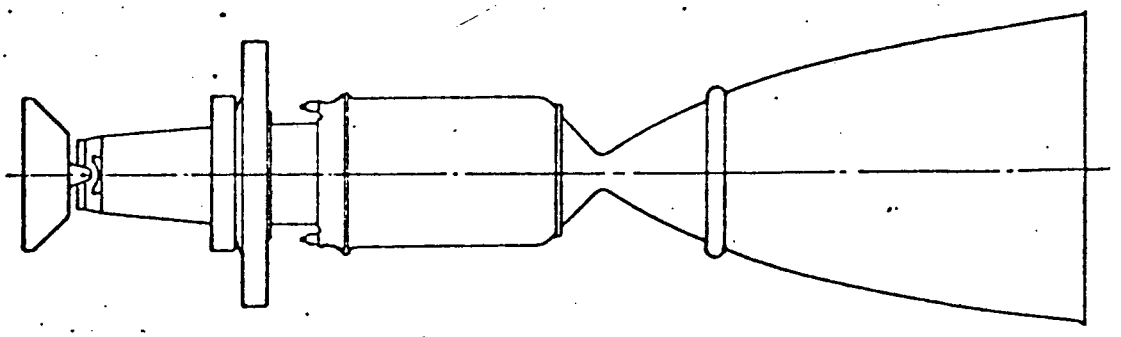


FIGURE 15-2



f = 2.369 Hz

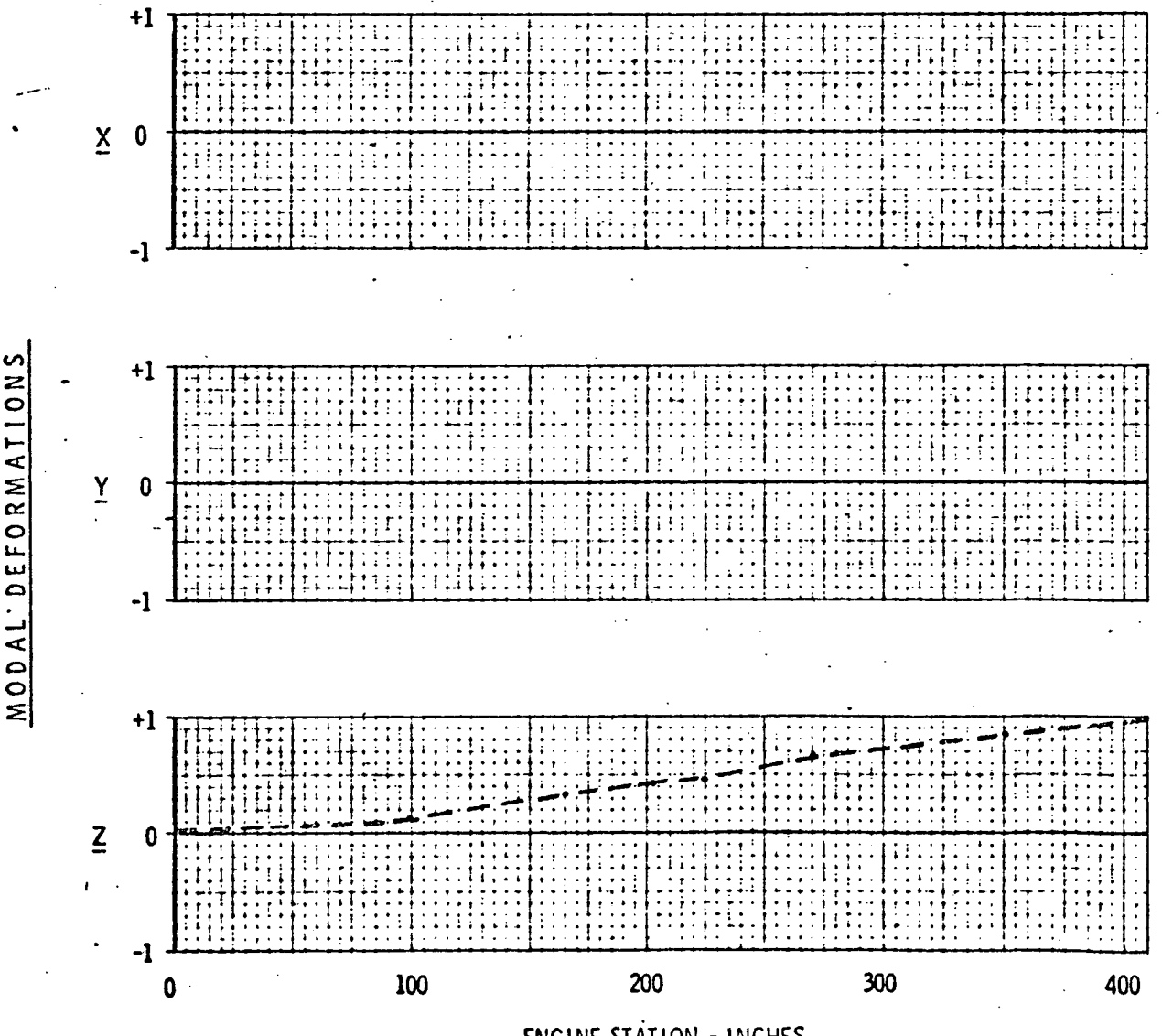
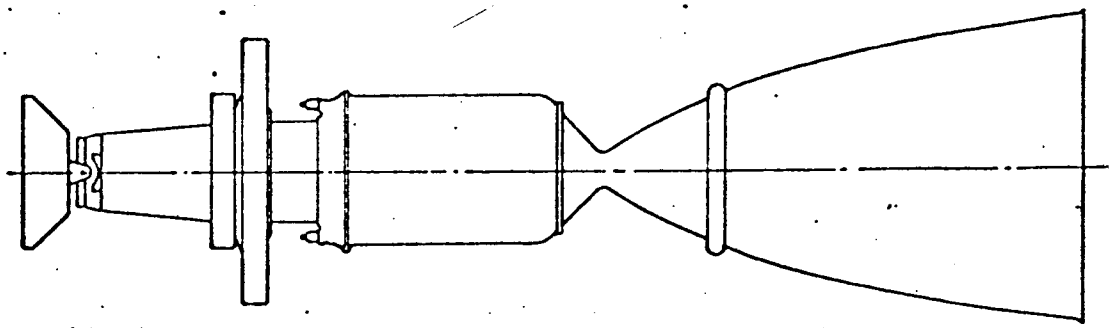


FIGURE 15-3



f = 3.966 Hz

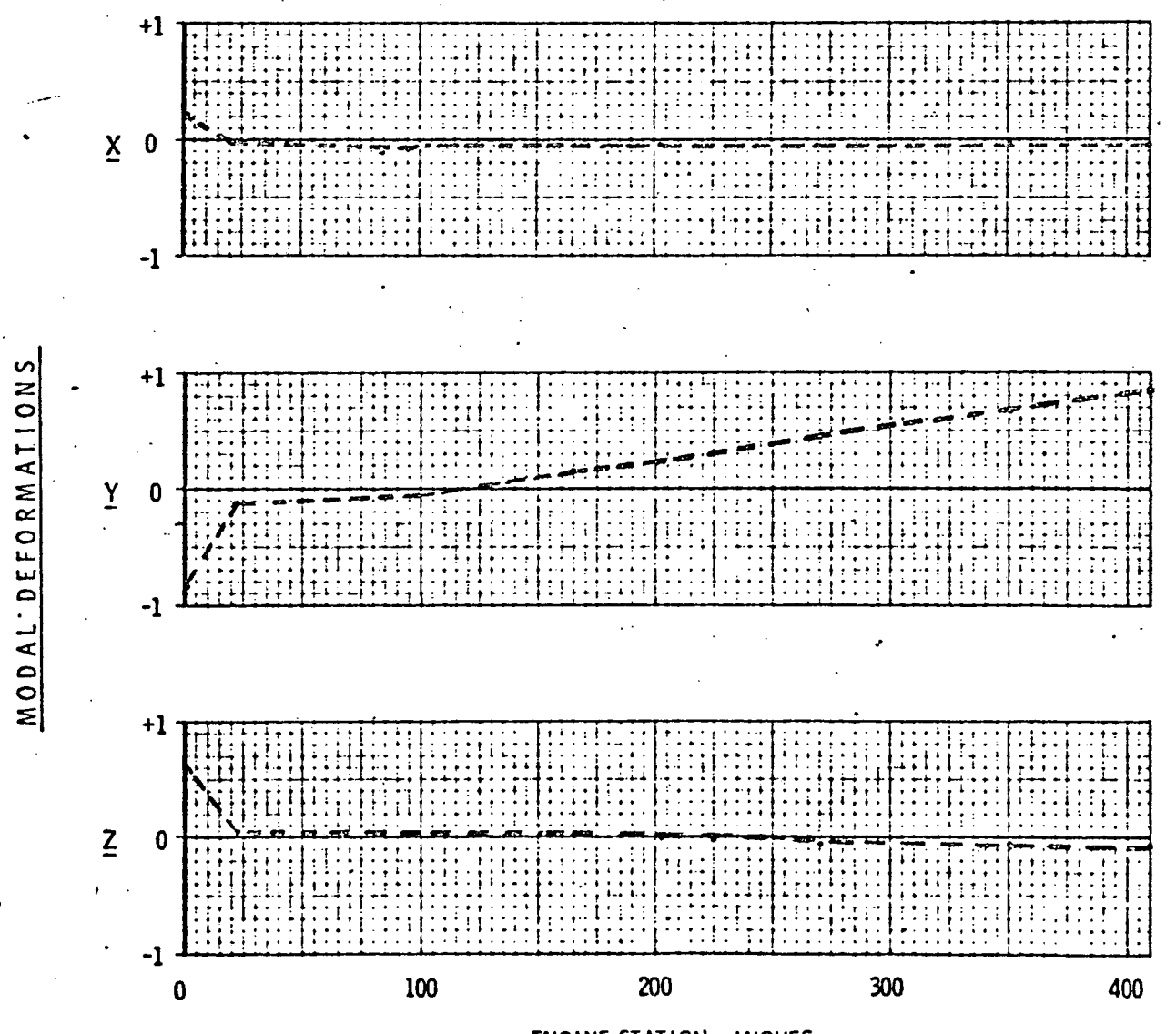
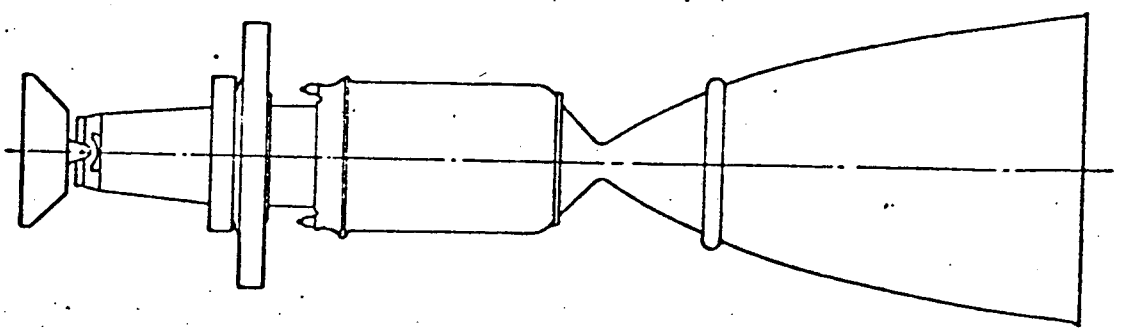


FIGURE 15-4



f = 9.291 Hz

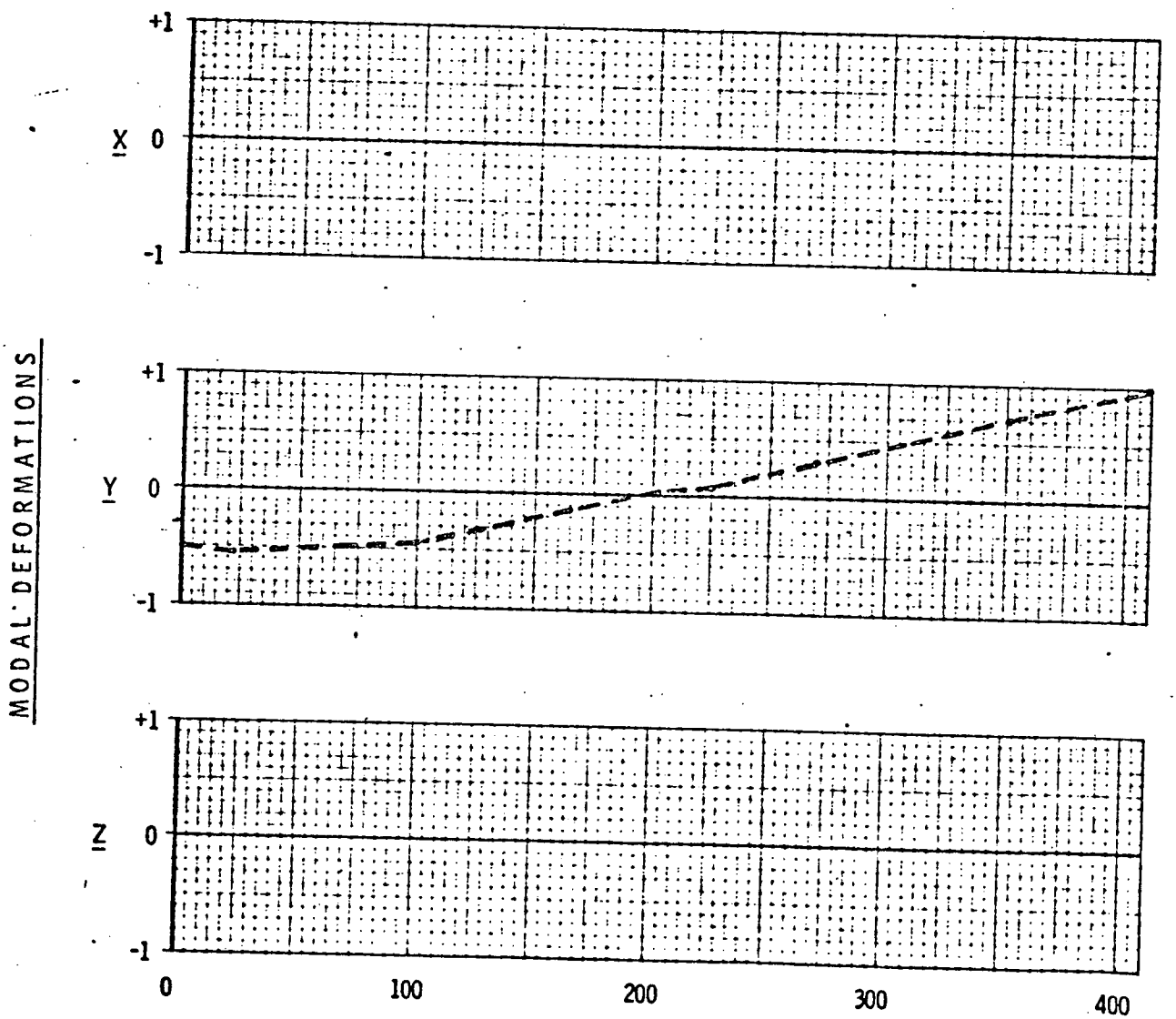
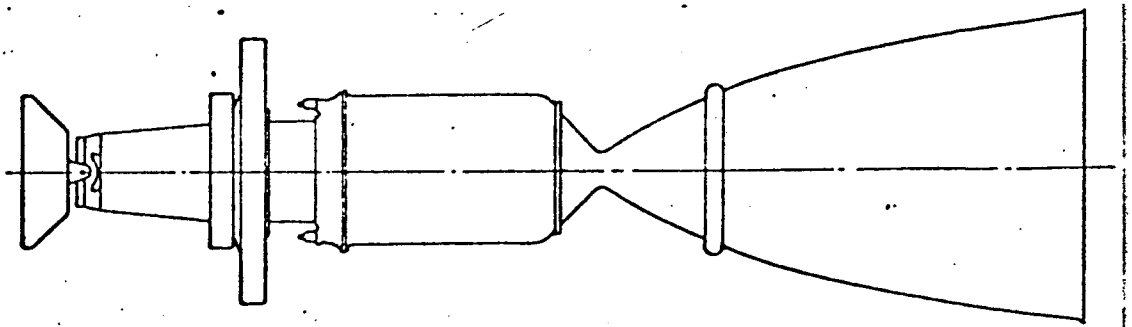


FIGURE 15-5



f = 9.931 Hz

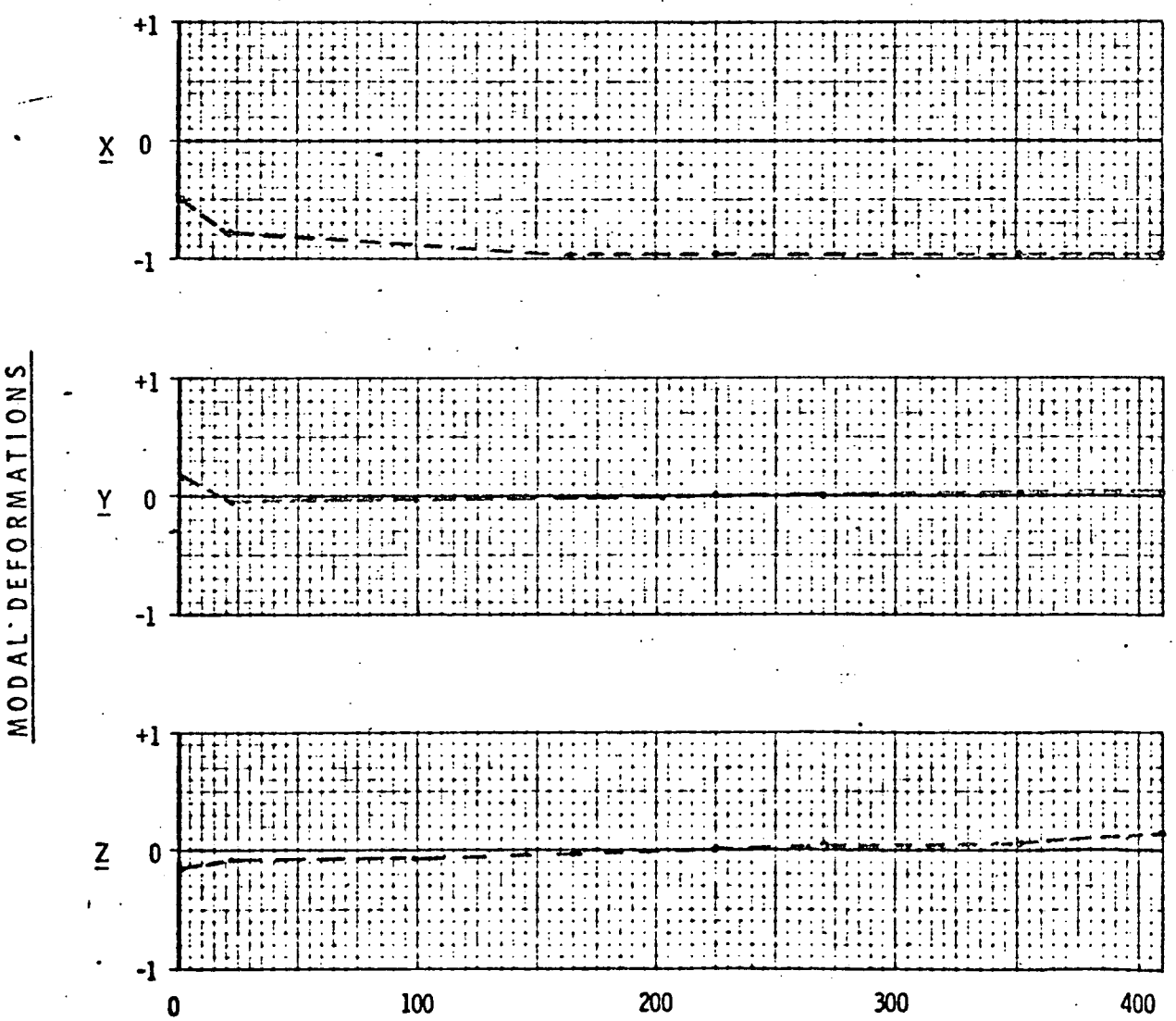
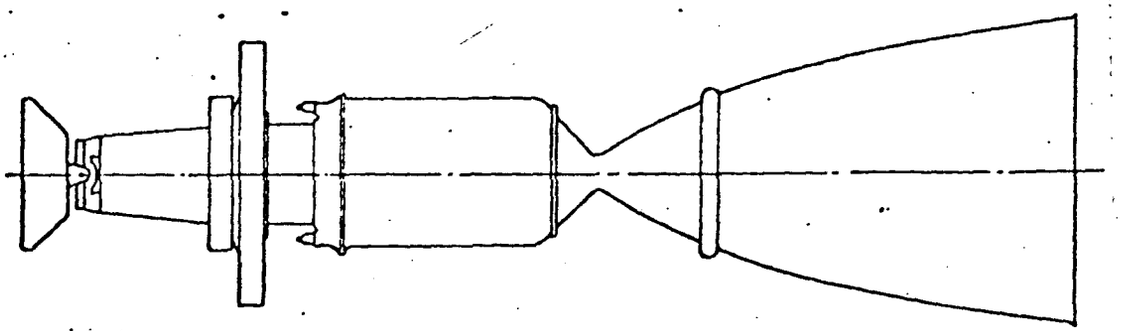


FIGURE 15-6



f = 14.144 Hz

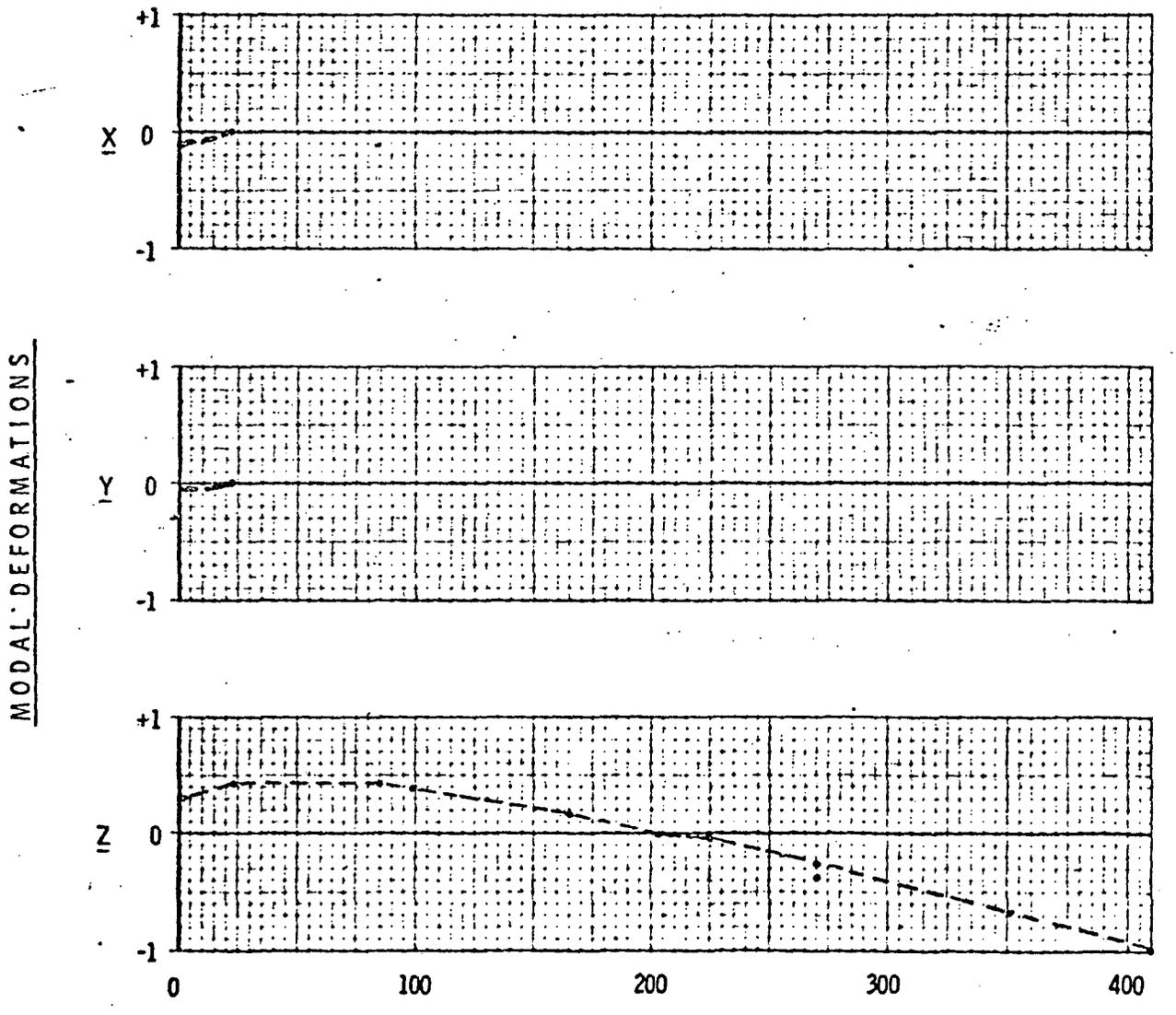
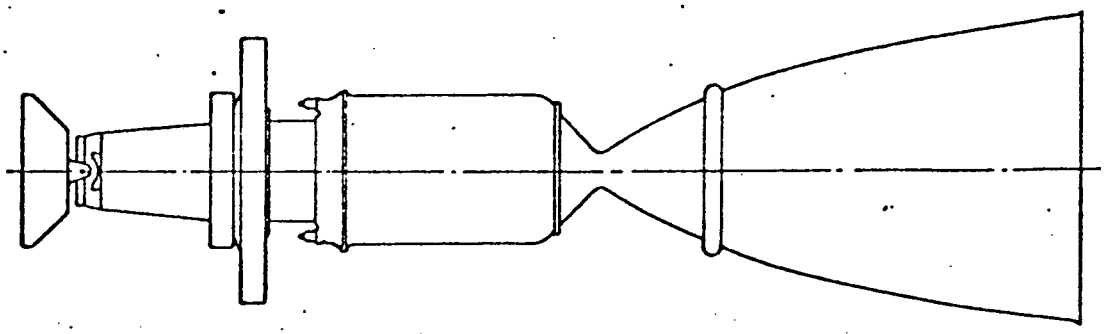


FIGURE 15-7



f = 27.835 Hz

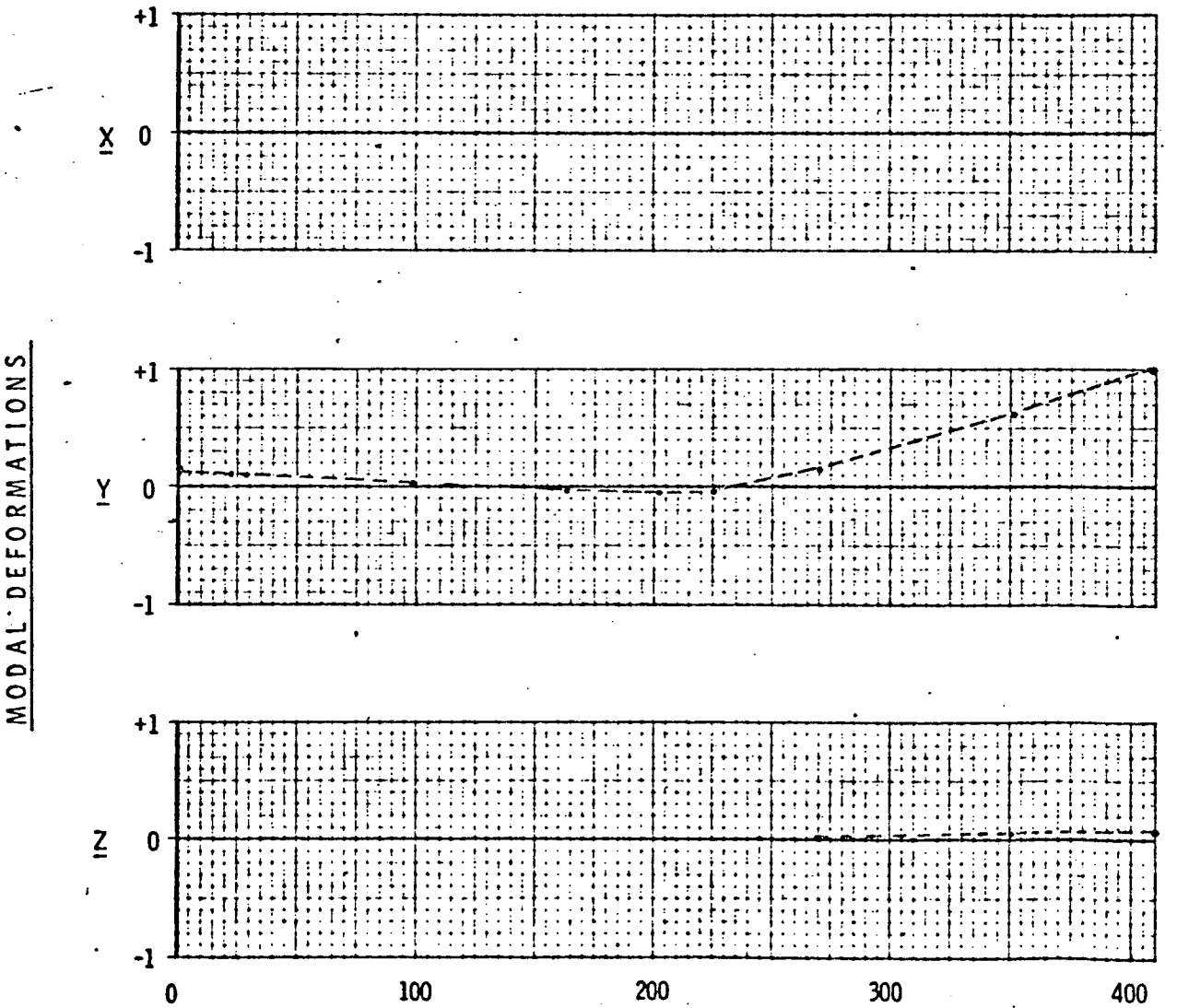
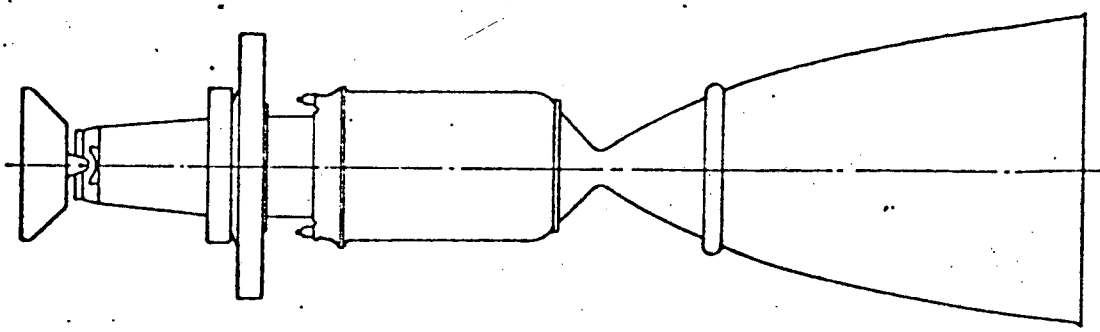


FIGURE 15-8



f = 28.592 Hz

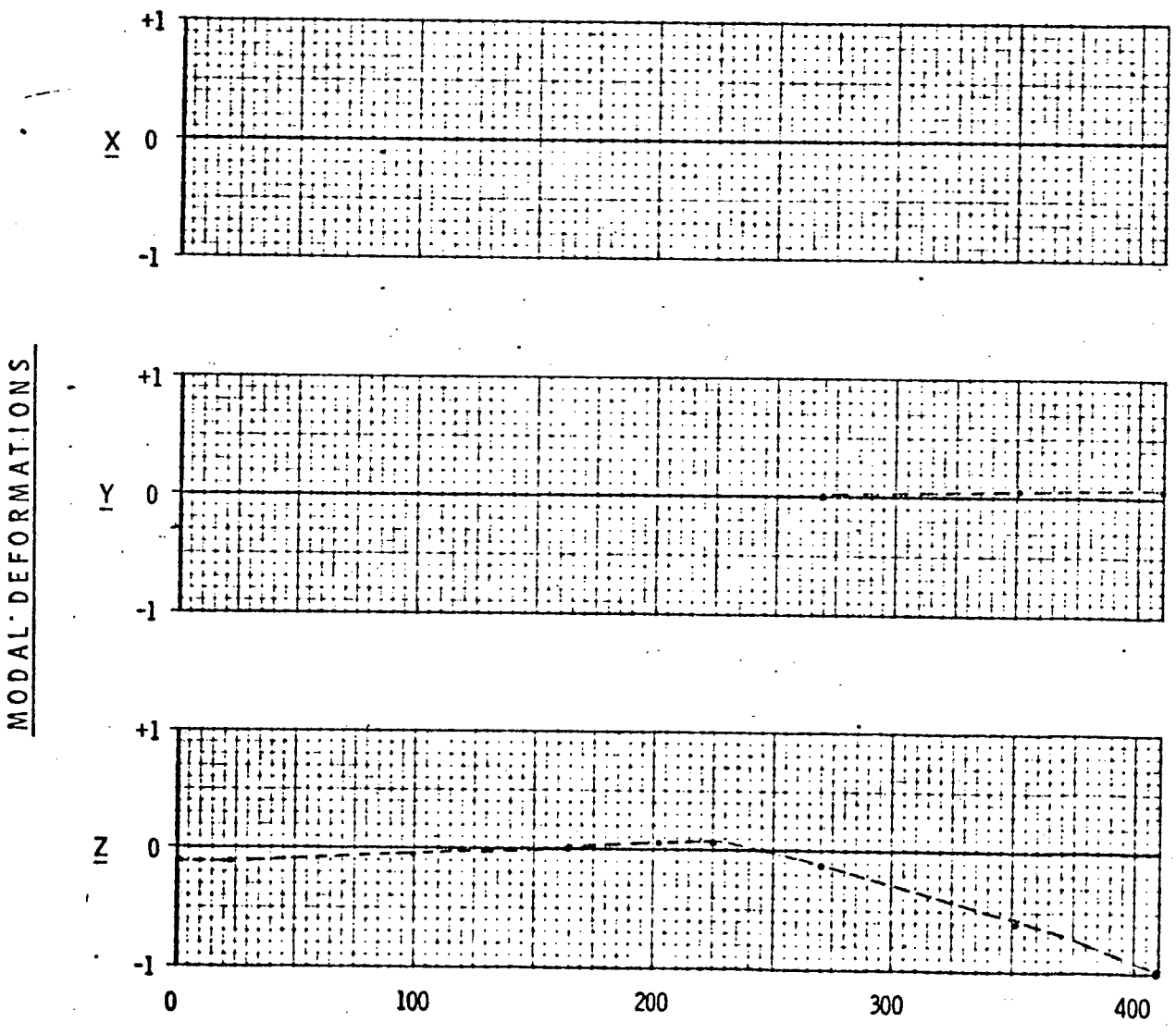
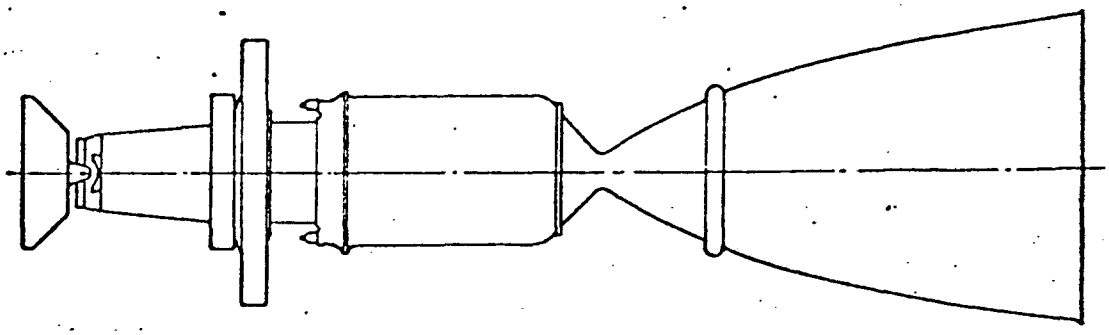


FIGURE 15-9



f = 36.321 Hz

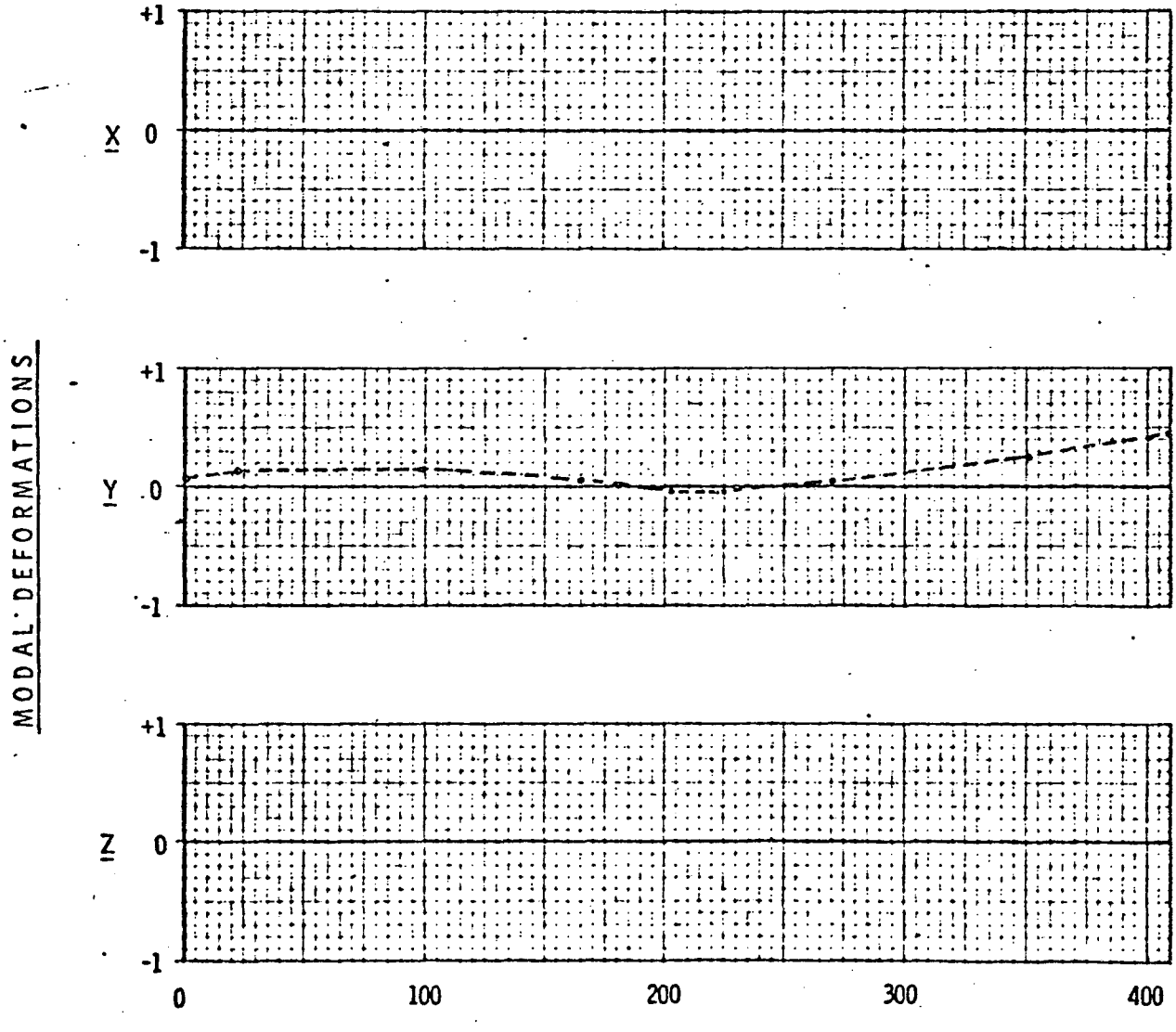
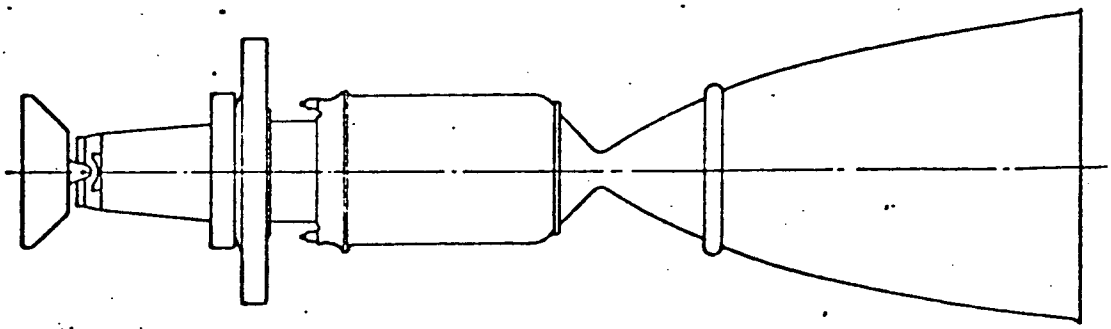


FIGURE 15-10



f = 53.025 Hz

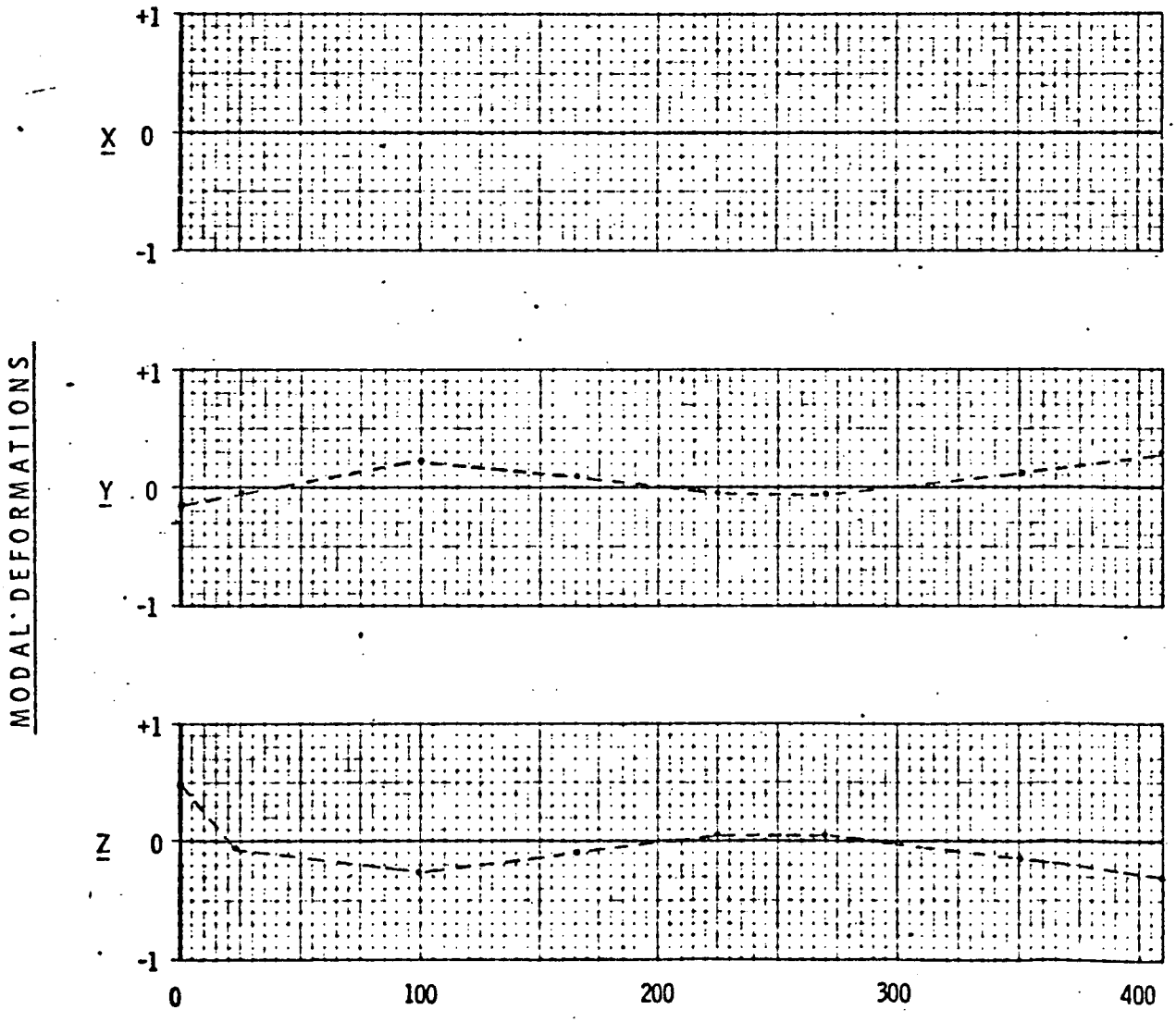
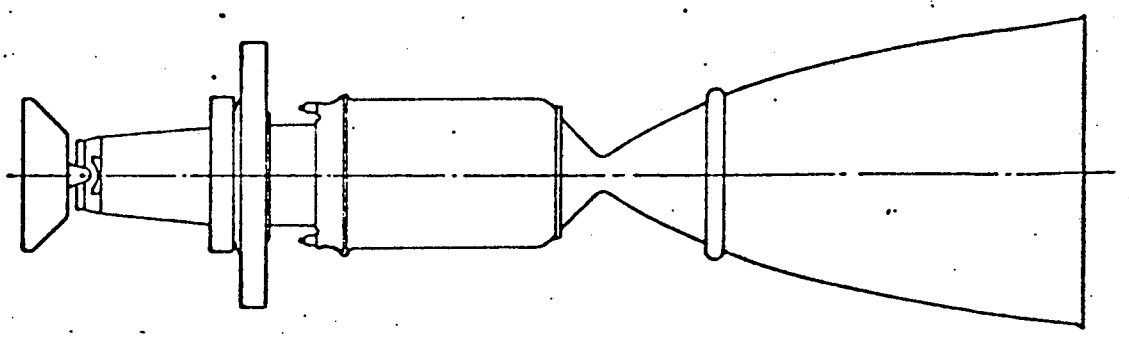


FIGURE 15-11



f = 56.869 Hz

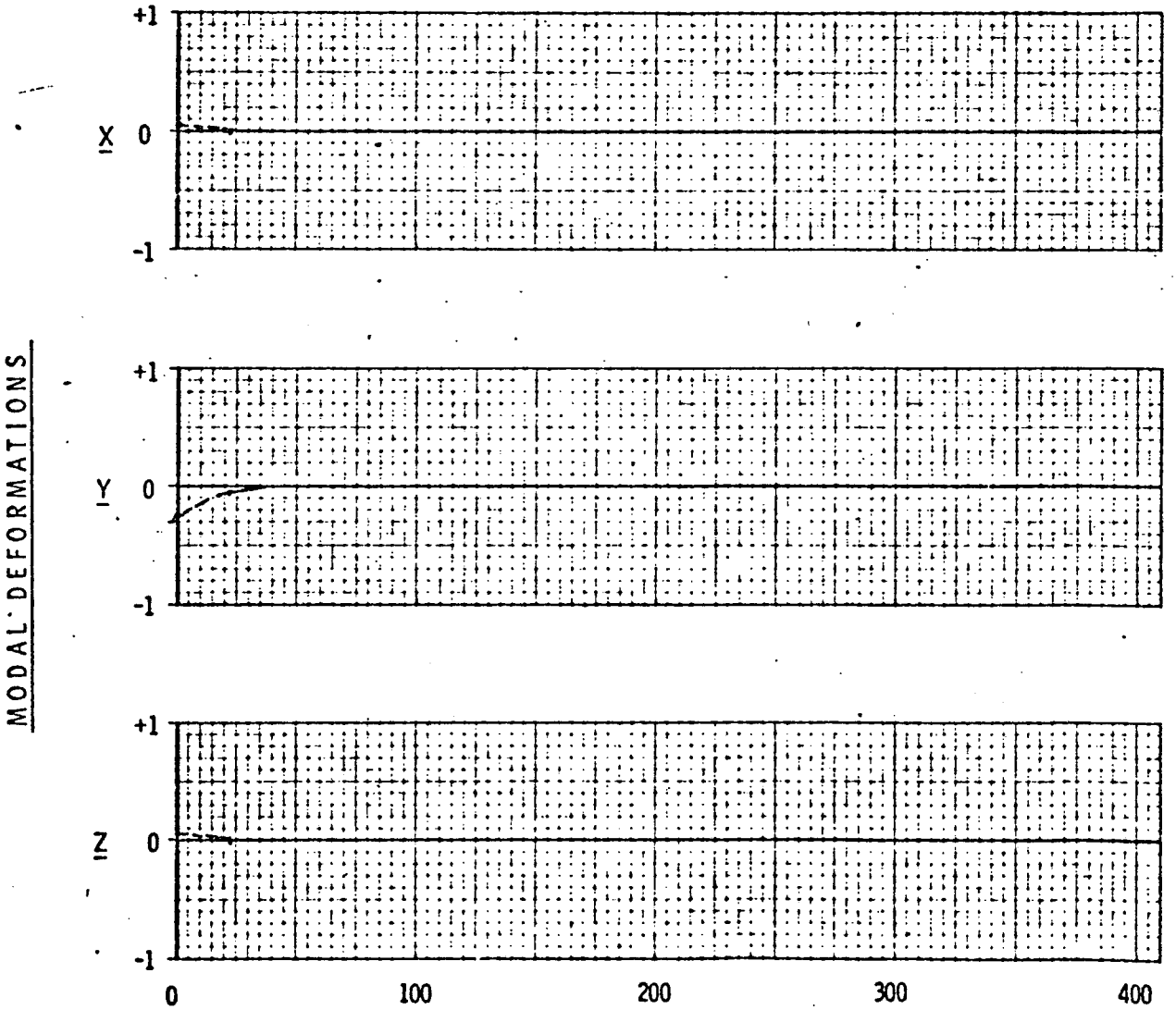
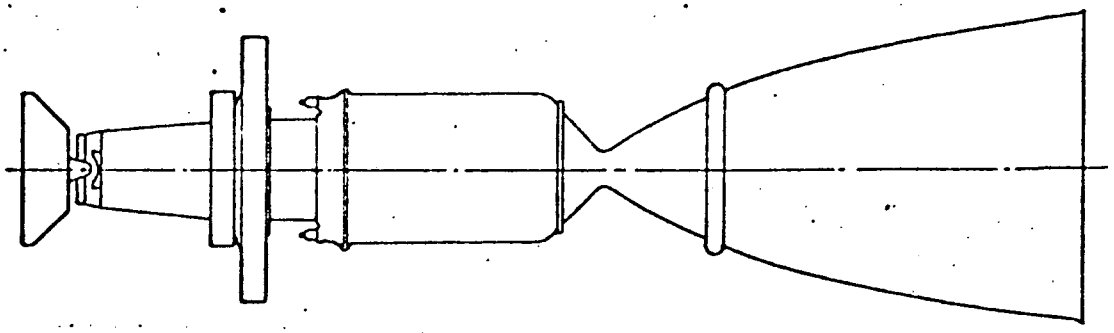


FIGURE 15-12



f = 63.558 Hz

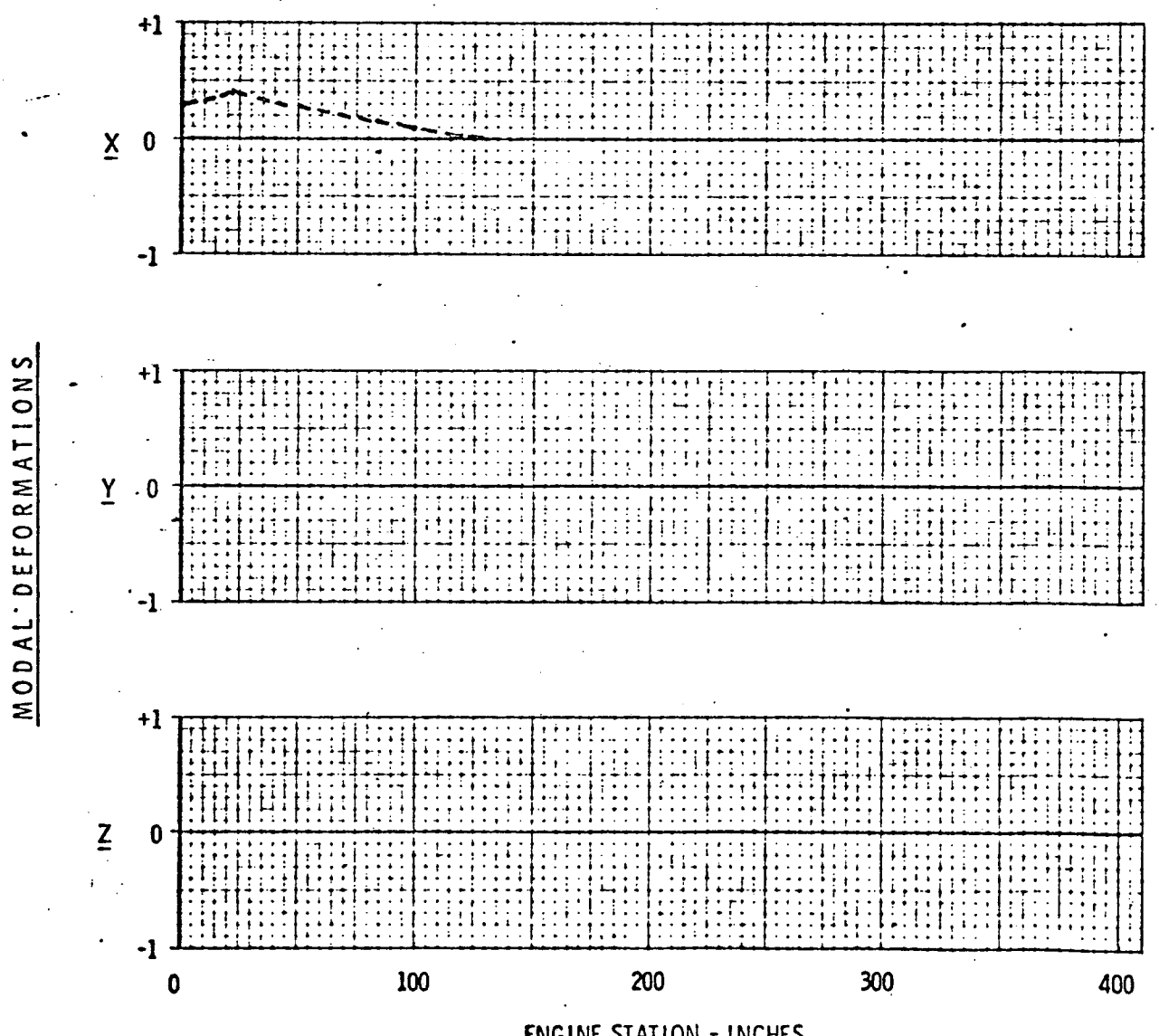
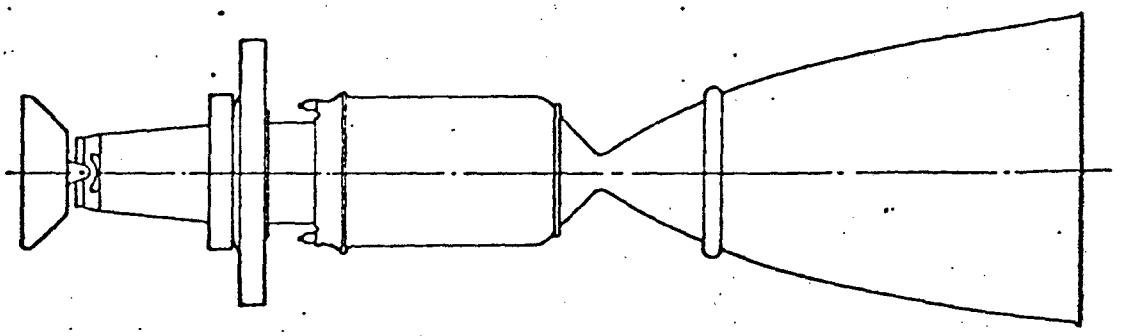


FIGURE 15-13



f = 69.558 Hz

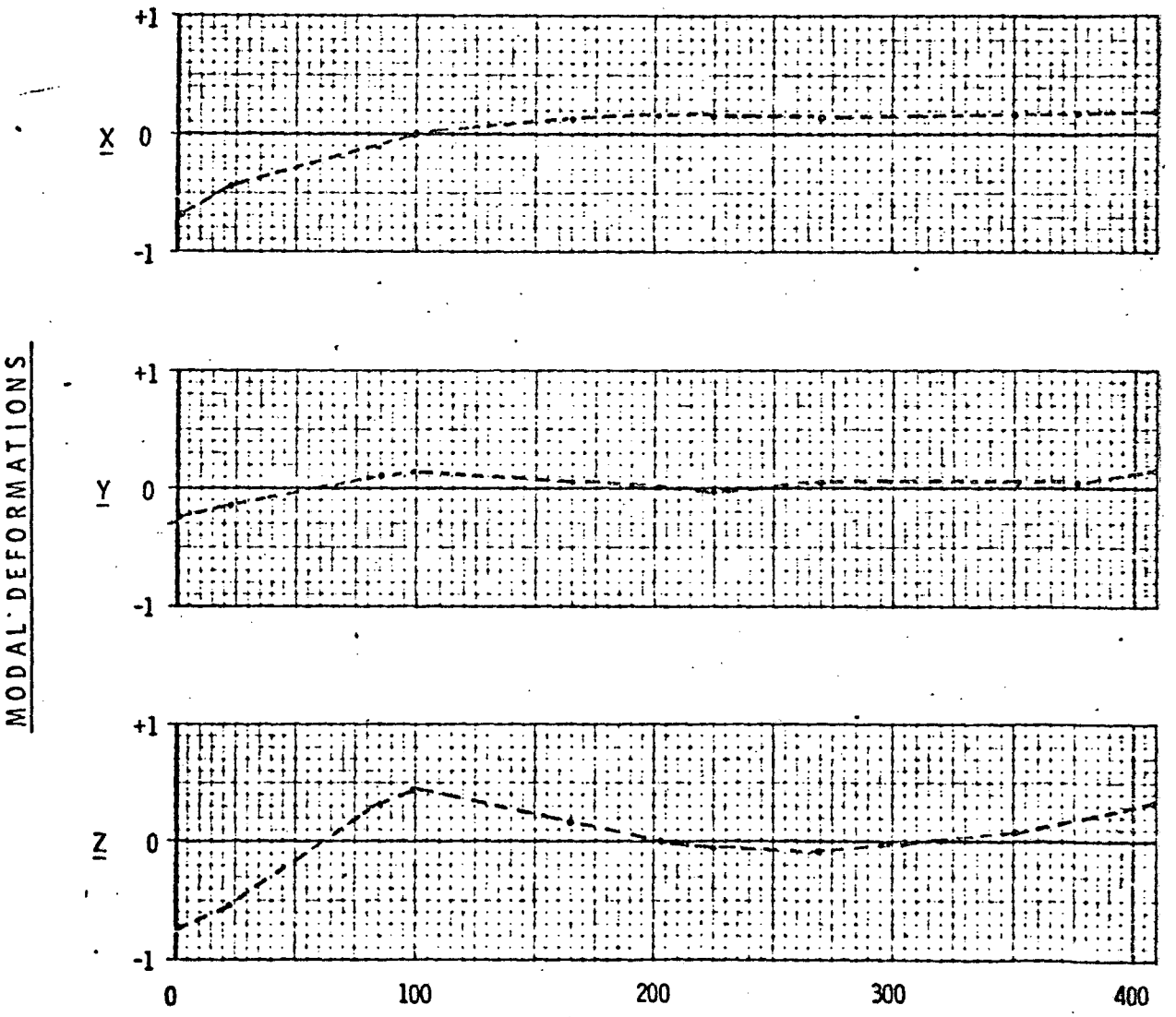
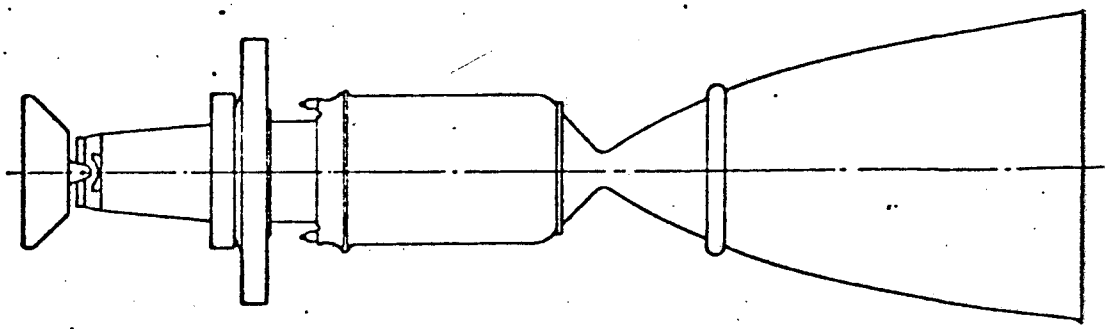


FIGURE 15-14



f = 71.857 Hz

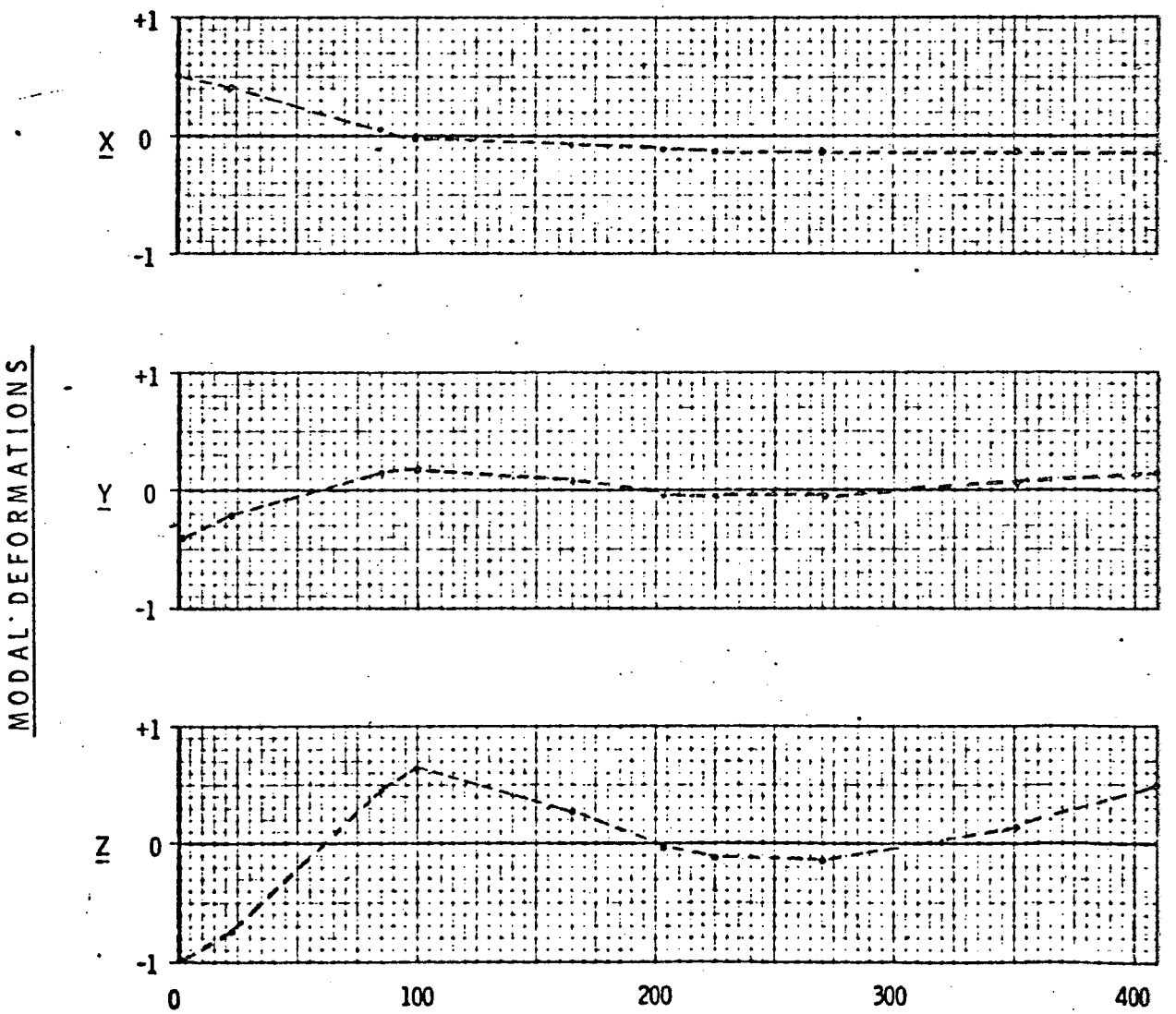


TABLE 1

400E THRUST TRAIN ANALYSES

	ENGINE ONLY	MINI-TANK
EOS	Case 1 & 2	Case 5 & 6
NSO		Case 7 & 8

Odd number cases are with shield

Even " " " without shield

TABLE 2

SUMMARY OF ENGINE NATURAL FREQUENCIES

0 - 100 Hz

CONFIGURATION:	EOS		EOS		NSO	
n/case	1	2	5	6	7	8
1	23.908	24.062	23.944	24.074	2.074	2.162
2	23.968	24.121	24.053	24.141	2.322	2.369
3	27.984	35.409	27.494	31.28	2.858	3.966
4	28.093	35.74	31.428	39.26	6.897	9.291
5	33.644	40.74	33.956	40.28	8.457	9.931
6	40.02	41.13	36.942	41.95	9.561	14.144
7	40.51	46.23	40.47	42.25	27.076	27.835
8	40.87	49.96	40.91	47.54	27.422	28.592
9	58.49	62.90	41.80	54.38	33.507	36.321
10	58.85	72.48	56.98	59.09	34.877	53.025
11	60.05	81.31	58.98	64.78	43.085	56.869
12	61.13	101.49	61.02	73.11	43.482	63.672
13	72.47	--	61.4	101.26	57.358	69.558
14	79.12	--	63.15	--	59.147	71.857
15	83.03	--	72.96	--	63.145	77.438
16	87.03	--	84.64	--	69.430	101.248
17	98.26	--	92.0	--	84.448	--
18	113.63	--	95.23	--	91.560	--
19	--	--	105.06	--	104.389	--

TABLE 3

EOS (ENGINE ONLY)

SUMMARY OF COORDINATE RESPONSES

(all values rms)

	WITH SHIELD						WITHOUT SHIELD					
	Acceleration - g's			Displacement - inches			Acceleration - g's			Displacement - inches		
Grid Point	$\ddot{X}$	$\ddot{Y}$	$\ddot{Z}$	X	Y	Z	$\ddot{X}$	$\ddot{Y}$	$\ddot{Z}$	X	Y	Z
2000	7.91	57.6	59.8	.086	.854	.866	6.98	88.	88.	.076	1.403	1.407
2050	7.47	10.5	10.5	.082	.167	.165	6.6	17.1	17.1	.073	.279	.281
3020	7.40	4.64	4.78	.081	.054	.054	6.5	6.2	6.6	.072	.067	.070
3050	7.4	4.5	4.7	.081	.049	.051	6.5	5.63	6.1	.072	.055	.058
4030	7.4	4.6	4.5	.081	.059	.058	6.3	4.2	4.2	.070	.048	.048
5010	7.4	5.0	4.9	.081	.065	.064	6.3	4.22	4.1	.070	.049	.049
6010	8.6	11.1	11.1	.092	.144	.144	6.2	7.0	6.4	.069	.069	.066
6040	9.6	24.3	24.3	.101	.311	.312	6.97	15.4	13.3	.076	.132	.119
6061	10.8	29.1	29.0	.113	.372	.372	8.	19.4	16.5	.085	.163	.144
6070	10.4	31.6	31.4	.109	.403	.402	7.7	21.2	17.9	.082	.177	.155
6080	10.4	-	-	.111	-	-	8.5	-	-	.086	-	-
6130	10.3	-	-	.109	-	-	8.7	-	-	.086	-	-
7030	10.43	32.8	32.6	.109	.418	.416	7.7	22.3	18.7	.082	.185	.162
8060	11.7	39.2	38.	.128	.497	.484	8.43	29.2	22.7	.087	.236	.193
8300	10.44	-	-	.110	-	-	8.81	-	-	.087	-	-
8400	10.5	-	-	.112	-	-	8.6	-	-	.087	-	-

TABLE 4

EOS (MINI-TANK CONFIGURATION)

SUMMARY OF COORDINATE RESPONSES

(all values rms)

	WITH SHIELD						WITHOUT SHIELD					
	Acceleration - g's			Displacement - inches			Acceleration - g's			Displacement - inches		
Grid Point	$\ddot{X}$	$\ddot{Y}$	$\ddot{Z}$	X	Y	Z	$\ddot{X}$	$\ddot{Y}$	$\ddot{Z}$	X	Y	Z
2000	8.75	32.6	35.7	.096	.393	.48	5.3	31.6	34.	.065	.475	.521
2050	8.3	4.01	5.54	.092	.066	.094	5.03	5.58	6.36	.062	.096	.109
3020	8.23	5.43	5.73	.091	.059	.062	4.99	3.78	3.73	.061	.047	.049
3050	8.21	5.51	5.73	.091	.060	.061	4.97	3.73	3.67	.061	.045	.046
4030	8.22	4.26	4.46	.091	.053	.054	4.85	2.83	2.87	.060	.036	.036
5010	8.21	4.12	4.34	.091	.054	.054	4.84	2.74	4.76	.060	.036	.034
6010	9.25	5.13	5.34	.101	.076	.067	4.69	3.3	2.72	.058	.043	.034
6040	9.93	10.36	9.17	.108	.145	.105	5.03	6.1	3.1	.062	.071	.037
6061	10.89	12.44	10.42	.117	.171	.117	5.49	7.52	3.3	.067	.086	.039
6070	10.42	13.56	10.94	.113	.185	.121	5.3	8.27	3.31	.065	.094	.039
6080	10.38	-	-	.113	-	-	5.35	-	-	.065	-	-
6130	10.40	-	-	.113	-	-	5.34	-	-	.065	-	-
7030	10.21	14.18	11.04	.110	.193	.122	5.24	8.83	3.30	.064	.10	.039
8060	8.89	16.22	8.29	.099	.217	.090	4.95	10.94	2.35	.061	.12	.027
8300	10.32	-	-	.112	-	-	5.3	-	-	.064	-	-
8400	10.27	-	-	.112	-	-	5.33	-	-	.064	-	-

TABLE 5

NSO

SUMMARY OF 3σ COORDINATE RESPONSES 0 - 100 Hz

(all values rms)

	WITH SHIELD						WITHOUT SHIELD					
	Acceleration - g's			Displacement - inches			Acceleration - g's			Displacement - inches		
Grid Point	$\ddot{X}$	$\ddot{Y}$	$\ddot{Z}$	X	Y	Z	$\ddot{X}$	$\ddot{Y}$	$\ddot{Z}$	X	Y	Z
2000	2.13	30.2	35.7	.082	.204	.221	1.66	25.1	46.6	.083	.192	.205
2050	1.54	1.54	1.54	.079	.079	.079	1.54	1.54	1.54	.079	.079	.079
3020	1.50	1.06	1.36	.08	.072	.073	1.53	1.65	1.87	.0786	.0728	.0737
3050	1.49	0.84	1.03	.079	.073	.074	1.52	0.96	1.26	.0784	.0738	.0750
4030	1.79	1.41	2.2	.076	.107	.11	1.44	8.05	7.42	.0737	.1063	.1092
5010	1.85	1.65	2.58	.075	.113	.117	1.43	8.96	8.56	.0734	.1125	.1158
6010	5.9	2.04	2.8	.069	.125	.128	1.27	8.42	8.15	.0684	.1237	.1266
6040	8.87	2.46	2.22	.081	.133	.134	1.48	3.86	3.48	.0852	.1311	.1322
6061	2.17	2.17	2.17	.134	.134	.134	2.21	2.21	2.21	.1324	.1324	.1324
6070	2.21	2.79	2.67	.109	.135	.133	1.90	2.94	2.65	.1108	.1338	.1311
6080	4.04	-	-	.099	-	-	4.76	-	-	.104	-	-
6130	4.24	-	-	.096	-	-	2.61	-	-	.099	-	-
7030	2.17	3.51	3.15	.1047	.1337	.131	1.96	3.77	3.14	.1066	.1322	.1290
8060	3.89	5.72	6.02	.074	.1312	.089	5.1	6.22	6.43	.0773	.1268	.0872
8300	4.28	-	-	.098	-	-	4.19	-	-	.1004	-	-
8400	4.09	-	-	.100	-	-	4.93	-	-	.1046	-	-

TABLE 6

EOS (ENGINE ONLY)

SUMMARY OF THRUST TRAIN LOADS

(all values rms)

		WITH SHIELD						WITHOUT SHIELD					
		(in-lb x 10^{-6})		(lbs x 10^{-3})		(lbs x 10^{-3})	(in-lb x 10^{-6})	(in-lb x 10^{-6})		(lbs x 10^{-3})		(lbs x 10^{-3})	(in-lb x 10^{-6})
Grid Point		BM-1	BM-2	S-1	S-2	Axial	Torque	BM-1	BM-2	S-1	S-2	Axial	Torque
2050	(+)	1.62	1.68	22.9	23.7	3.71	.0	2.57	2.58	36.6	36.8	3.38	0
	(-)	1.60	1.65	20.53	21.15	6.89	.045	2.54	2.54	33.4	33.6	6.23	.037
3020	(+)	2.54	2.62	21.77	22.33	8.6	.045	4.07	4.08	35.7	35.9	7.74	.037
	(-)	2.54	2.62	22.08	22.6	9.84	.045	4.07	4.08	36.5	36.6	8.84	.037
3050	(+)	2.95	3.04	22.08	22.6	9.84	.045	4.76	4.77	36.5	36.7	8.84	.037
	(-)	2.95	3.04	41.7	45.8	9.61	.045	4.77	4.78	48.	50.	24.5	.040
4030	(+)	4.68	5.31	43.4	47.3	3.2	.045	1.70	1.75	49.2	50.8	31.8	.040
	(-)	4.68	5.31	44.5	48.1	3.6	.045	1.70	1.75	49.7	51.4	33.7	.040
5000	(+)	4.86	5.53	44.5	48.1	3.6	.045	1.67	1.75	49.7	51.4	33.7	.040
	(-)	4.86	5.53	45.4	48.9	4.8	.045	1.67	1.75	50.3	51.8	35.2	.040
5010	(+)	5.07	5.76	45.4	48.9	4.8	.045	1.7	1.8	50.3	51.8	35.2	.040
	(-)	5.06	4.99	49.	52.6	10.7	1.23	1.69	1.4	51.6	53.9	40.8	.274
6000	(+)	5.56	5.54	49.	52.6	10.7	1.23	1.90	1.62	51.6	53.9	40.8	.274
	(-)	5.56	5.54	206.	207.	129.	1.22	1.90	1.62	71.	61.3	33.4	.272
6010	(+)	3.18	3.16	206.	207.	129.	1.22	1.08	.908	71.	61.3	33.4	.272
	(-)	.53	.50	107.	107.	44.3	.37	1.08	.908	70.	60.5	32.7	.272
6020	(+)	.75	.79	107.	107.	44.3	.37	.256	.208	70.	60.5	32.7	.272
	(-)	.75	.79	94.6	95.	38.	.37	.256	.208	63.	54.3	28.4	.272
7030	(+Y)	.025	.019	2.5	1.81	2.42	0	.016	.013	1.60	1.31	1.66	0
	(-Y)	.023	.019	2.18	1.82	2.4	0	.012	.013	1.14	1.31	1.67	0
	(+Z)	.014	.0095	2.66	1.85	2.6	0	.010	.007	1.98	1.34	1.53	0
	(-Z)	.014	.0095	2.62	1.85	2.6	0	.009	.007	1.67	1.34	1.53	0

TABLE 7

EOS (MINI-TANK CONFIGURATION)

SUMMARY OF THRUST TRAIN LOADS

(all values rms)

		WITH SHIELD						WITHOUT SHIELD					
		(in-lb x 10^{-6})		(lbs x 10^{-3})		(lbs x 10^{-3})	(in-lb x 10^{-6})	(in-lb x 10^{-6})		(lbs x 10^{-3})		(lbs x 10^{-3})	(in-lb x 10^{-6})
Grid Point		BM-1	BM-2	S-1	S-2	Axial	Torque	BM-1	BM-2	S-1	S-2	Axial	Torque
2050	(+)	1.85	12.12	26.03	30.04	3.83	0	2.27	2.48	32.4	35.6	2.55	0
	(-)	1.83	2.08	23.13	27.26	7.13	.052	2.24	2.44	29.76	32.75	4.72	.035
3020	(+)	2.88	3.33	24.37	29.05	8.91	.052	3.61	3.96	31.94	35.22	5.85	.035
	(-)	2.88	3.33	24.58	29.63	10.21	.052	3.61	3.96	32.75	36.18	6.67	.035
3050	(+)	3.34	3.89	24.58	29.63	10.21	.052	4.23	4.64	32.75	36.18	6.67	.035
	(-)	3.34	3.89	39.52	48.26	5.53	.055	4.24	4.65	42.82	44.73	20.97	.037
4030	(+)	5.02	3.64	40.58	48.63	5.01	.055	2.06	.87	42.90	44.5	26.44	.037
	(-)	5.02	3.64	41.56	49.53	7.11	.055	2.06	.87	43.34	44.85	27.84	.037
5000	(+)	5.19	3.78	41.56	49.53	7.11	.055	2.07	.647	43.34	44.85	27.84	.037
	(-)	5.19	3.78	42.31	50.14	8.94	.055	2.07	.647	43.61	45.	29.	.037
5010	(+)	5.37	3.94	42.31	50.14	8.94	.055	2.11	.429	43.61	45.	29.	.037
	(-)	5.35	3.19	45.81	53.21	15.8	1.46	2.10	.56	44.51	46.	33.3	.108
6000	(+)	5.80	3.60	45.81	53.21	15.8	1.46	2.29	.248	44.51	46.	33.3	.108
	(-)	5.80	3.60	208.94	142.24	124.79	1.46	2.29	.248	83.86	8.76	18.44	.104
6010	(+)	3.40	2.01	208.94	142.24	124.79	1.46	1.31	.15	83.86	8.76	18.44	.104
	(-)	.654	.295	115.02	54.99	32.96	.316	1.31	.15	83.08	8.46	17.89	.104
6020	(+)	.73	.923	115.02	54.99	32.96	.316	.329	.066	83.08	8.46	17.89	.104
	(-)	.73	.923	103.63	45.13	26.	.316	.329	.066	76.8	6.7	14.92	.104
7030	(+Y)	.149	.067	14.5	6.54	7.17	0	.027	.03	2.56	2.91	11.19	0
	(-Y)	.130	.067	12.71	6.54	6.77		.026	.03	2.48	2.91	10.84	0
	(+Z)	.033	.033	6.53	6.46	13.30	0	.051	.015	10.24	2.88	2.4	0
	(-Z)	.048	.033	8.76	6.46	13.30	0	.064	.015	12.16	2.88	2.4	0

TABLE 8

NSO

SUMMARY OF 3σ THRUST TRAIN LOADS 0 - 100 Hz

(all values rms)

		WITH SHIELD						WITHOUT SHIELD					
		(in-lb x 10^{-6})		(lbs x 10^{-3})		(lbs x 10^{-3})	(in-lb x 10^{-6})	(in-lb x 10^{-6})		(lbs x 10^{-3})		(lbs x 10^{-3})	(in-lb x 10^{-6})
Grid Point		BM-1	BM-2	S-1	S-2	Axial	Torque	BM-1	BM-2	S-1	S-2	Axial	Torque
2050	(+)	.841	.81	5.2	5.9	4.5	0	.343	.535	3.35	3.76	5.85	0
	(-)	.78	.77	15.3	15.	8.4	.023	.335	.507	6.16	9.97	10.2	.539
3020	(+)	.561	.64	20.7	20.2	10.4	.023	.371	.410	7.54	12.62	12.52	.539
	(-)	.57	.64	23.	22.2	11.9	.023	.371	.410	8.08	13.67	14.2	.539
3050	(+)	.83	.90	23.	22.2	11.9	.023	.462	.560	8.08	13.67	14.2	.539
	(-)	.84	.91	15.2	13.6	143.6	.047	.457	.561	11.08	3.99	174.7	.634
4030	(+)	.57	.64	13.5	12.1	153.	.047	.508	.470	5.91	3.86	182.9	.635
	(-)	.57	.64	12.9	11.3	155.2	.047	.508	.470	4.48	5.4	184.3	.635
5000	(+)	.63	.67	12.9	11.3	155.2	.047	.518	.478	4.48	5.4	184.3	.635
	(-)	.63	.67	12.3	10.6	157.1	.047	.518	.478	3.88	7.09	185.3	.635
5010	(+)	.69	.71	12.3	10.6	157.1	.047	.519	.494	3.88	7.09	185.3	.635
	(-)	.70	.92	10.0	7.9	163.5	.72	.512	.771	7.96	14.90	187.9	.170
6000	(+)	.80	1.01	10.0	7.9	163.5	.72	.428	.602	7.96	14.90	187.9	.170
	(-)	.80	1.01	9.6	7.5	164.	.72	.428	.602	9.12	16.11	187.2	.170
6010	(+)	.89	1.09	9.6	7.5	164.	.72	.344	.441	9.12	16.11	187.2	.170
	(-)	.72	1.05	21.	35.5	192.2	.23	.344	.441	10.08	17.03	185.2	.170
6020	(+)	.72	1.05	21.	35.5	192.2	.23	.265	.301	10.08	17.03	185.2	.170
	(-)	.41	.50	22.6	37.6	187.	.23	.265	.301	13.24	19.42	169.2	.170
7030	(+Y)	.11	.12	10.2	11.6	3.4	0	.085	.119	8.3	11.6	2.95	0
	(-Y)	.11	.12	10.	11.6	3.3	0	.090	.119	8.79	11.60	2.87	0
	(+Z)	.07	.06	10.5	11.2	7.5	0	.041	.058	6.24	11.24	7.5	0
	(-Z)	.07	.06	10.4	11.2	7.5	0	.046	.058	7.13	11.25	7.5	0

TABLE 9

ACTUATOR LOADS (LBS)

Case	Actuator No. 1	Actuator No. 2
1	1203	1209
2	1284	1388
5	1190	1058
6	256	346
7	687	1837
8	876	1615

GRID POINT	ISN*	DEGREES OF FREEDOM						DESCRIPTION
		X	Y	Z	θ_x	θ_y	θ_z	
2000	1	1	2	3	4	5	6	Nozzle Extension
2010	2	7	8	9	10	11	12	" "
2020	3	13	14	15	16	17	18	" "
2030	4	19	20	21	22	23	24	" "
2040	5	25	26	27	28	29	30	" "
2050	6	31	32	33	34	35	36	" "
3000	7	37	38	39	40	41	42	Nozzle
3010	8	43	44	45	46	47	48	"
3020	9	49	50	51	52	53	54	"
3030	10	55	56	57	58	59	60	"
3040	11	61	62	63	64	65	66	"
3050	12	67	68	69	70	71	72	"
3051	13	73	74	75	76	77	78	EOS Support Frame, Aft
3052	14	79	80	81	82	83	84	" " " "
3053	15	85	86	87	88	89	90	" " " "
3054	16	91	92	93	94	95	96	" " " "
3055	17	97	98	99	100	101	102	" " " "
3056	18	103	104	105	106	107	108	" " " "
4000	19	109	110	111	112	113	114	Pressure Vessel
4001	20	115	116	117	118	119	120	Nuclear Subsystem
4002	21	121	122	123	124	125	126	" "
4003	22	127	128	129	130	131	132	" "
4010	23	133	134	135	136	137	138	Pressure Vessel
4020	24	139	140	141	142	143	144	" "
4030	25	145	146	147	148	149	150	" "

*Internal [redacted]uence Number

TAB[redacted]10 (Cont.)

GRID POINT	ISN*	DEGREES OF FREEDOM						DESCRIPTION
		X	Y	Z	θ_x	θ_y	θ_z	
5000	26	151	152	153	154	155	156	Pressure Vessel Fwd Closure
5010	27	157	158	159	160	161	162	" " " "
6000	28	163	164	165	166	167	168	Lower Thrust Structure
6001	29	169	170	171	172	173	174	EOS Support Frame, Fwd
6002	30	175	176	177	178	179	180	" " " "
6003	31	181	182	183	184	185	186	" " " "
6004	32	187	188	189	190	191	192	" " " "
6005	33	193	194	195	196	197	198	" " " "
6006	34	199	200	201	202	203	204	" " " "
6010	35	205	206	207	208	209	210	Lower Thrust Structure
6020	36	211	212	213	214	215	216	" " "
6030	37	217	218	219	220	221	222	" " "
6040	38	223	224	225	226	227	228	" " "
6050	39	229	230	231	232	233	234	" " "
6060	40	235	236	237	238	239	240	" " "
6070	41	241	242	243	244	245	246	" " "
6071	42	247	248	249	250	251	252	" " "
6072	43	253	254	255	256	257	258	" " "
6080	44	259	260	261	262	263	264	Actuator Aft Attach Point
6130	45	265	266	267	268	269	270	" " " "
7000	46	271	272	273	274	275	276	Gimbal
7010	47	277	278	279	280	281	282	"
7020	48	283	284	285	286	287	288	"
7030	49	289	290	291	292	293	294	"
7040	50	295	296	297	298	299	300	"

GRID POINT	ISN*	DEGREES OF FREEDOM						DESCRIPTION
		X	Y	Z	θ_x	θ_y	θ_z	
8000	51	301	302	303	304	305	306	Upper Thrust Structure
8001	52	307	308	309	310	311	312	" " "
8002	53	313	314	315	316	317	318	" " "
8005	54	319	320	321	322	323	324	" " "
8010	55	325	326	327	328	329	330	" " "
8020	56	331	332	333	334	335	336	" " "
8021	57	337	338	339	340	341	342	" " "
8022	58	343	344	345	346	347	348	" " "
8025	59	349	350	351	352	353	354	" " "
8030	60	355	356	357	358	359	360	" " "
8040	61	361	362	363	364	365	366	" " "
8050	62	367	368	369	370	371	372	" " "
8060	63	373	374	375	376	377	378	" " "
8070	64	379	380	381	382	383	384	" " "
8080	65	385	386	387	388	389	390	" " "
8090	66	391	392	393	394	395	396	" " "
8100	67	397	398	399	400	401	402	" " "
8110	68	403	404	405	406	407	408	" " "
8120	69	409	410	411	412	413	414	" " "
8130	70	415	416	417	418	419	420	" " "
8140	71	421	422	423	424	425	426	" " "
8150	72	427	428	429	430	431	432	" " "
8160	73	433	434	435	436	437	438	" " "
8170	74	439	440	441	442	443	444	" " "
8180	75	445	446	447	448	449	450	" " "

GRID POINT	ISN*	DEGREES OF FREEDOM						DESCRIPTION
		X	Y	Z	θ_x	θ_y	θ_z	
8190	76	451	452	453	454	455	456	Upper Thrust Structure
8200	77	457	458	459	460	461	462	" " "
8210	78	463	464	465	466	467	468	" " "
8300	79	469	470	471	472	473	474	Actuator Fwd Attach Point
8400	80	475	476	477	478	479	480	" " " "
999000	81	481	482	483	484	485	486	Used For Plot Orientation Only
999001	82	487	488	489	490	491	492	" " " " "
999002	83	493	494	495	496	497	498	" " " " "
999003	84	499	500	501	502	503	504	" " " " "
999004	85	505	506	507	508	509	510	" " " " "

TABLE 11

MINI-TANK MODAL DATA

n	$f_n \sim$ Hz	M_n	K_n ($\times 10^{-6}$)
1	0	2.927	0
2	0	2.927	0
3	0	0.664	0
4	155.5	1.311	1.251
5	268.1	0.444	1.262
6	305.9	0.2018	0.7457
7	328.	0.1584	0.6729
8	339.3	0.1940	0.8818
9	350.6	0.2043	0.9914

TABLE 12

ENGINE ASSEMBLY SUPPORT STIFFNESS

Grid Point	K_x	K_y	K_z	θ_x
	(lb/inch x 10^{-6})			(in-lb/rad x 10^{-6})
3050	3.5	3.5	3.5	40.
6000	3.5	3.5	3.5	40.

TABLE 13

TYPICAL ACCELERATION RESPONSE

	f Hz	a g's
	22.5	1.96
	23.0	1.99
	23.5	2.02
*	24.062	2.06
*	24.121	2.06
	24.50	2.08
	25.0	2.12
	33.5	3.13
	34.0	3.24
	34.5	3.35
	35.0	3.47
*	35.409	3.57
*	35.740	3.65
	36.0	3.72
	36.5	3.88
	37.0	4.06
	37.5	4.26
	Σ =	50.6
	RSS =	12.7
	NARROW BAND =	6.98

* Engine Natural Frequencies

TABLE 14

ENGINE NATURAL FREQUENCIES

CASE 1

n	f_n - Hz	Identification
1	23.908	1st nozzle bending + Y, + Z
2	23.968	1st nozzle bending + Y, - Z
3	27.984	1st engine bending X - Z plane
4	28.093	1st engine bending X - Y plane
5	33.644	UTS/Actuator
6	40.02	1st axial EAS
7	40.51	2nd nozzle bending X - Z plane
8	40.87	2nd nozzle bending X - Y plane
9	58.49	UTS
10	58.85	UTS/LTS bending
11	60.05	1st NSS
12	61.13	2nd engine bending X - Y plane
13	72.47	1st engine axial

TABLE 15

ENGINE NATURAL FREQUENCIES

CASE 2

n	f_n - Hz	Identification
1	24.062	1st nozzle bending + Y, + Z
2	24.121	1st nozzle bending + Y, - Z
3	35.409	1st engine bending X - Z plane
4	35.74	1st engine bending X - Y plane
5	40.74	2nd engine bending X - Z plane
6	41.13	2nd engine bending X - Y plane
7	46.23	1st axial EAS
8	49.96	UTS/Actuator
9	62.90	1st NSS
10	72.48	2nd NSS

TABLE 16

ENGINE NATURAL FREQUENCIES

CASE 5

n	f_n - Hz	Identification
1	23.944	1st nozzle bending X - Y plane
2	24.053	1st nozzle bending X - Z plane
3	27.494	1st engine bending X - Y plane
4	31.428	1st engine bending X - Z plane + UTS
5	33.956	1st engine bending + mini-tank
6	36.942	2nd nozzle bending X - Z plane
7	40.47	mini-tank + local UTS
8	40.91	2nd nozzle bending X - Y plane
9	41.80	1st EAS axial
10	56.98	UTS + mini-tank
11	58.98	EAS X - Z plane + engine bending
12	61.02	1st NSS
13	61.4	EAS X - Y plane + engine bending
14	63.15	UTS/mini-tank
15	72.96	1st EAS axial

TABLE 17

ENGINE NATURAL FREQUENCIES

CASE 6

n	f_n - Hz	Identification
1	24.074	1st nozzle bending + Y, + Z
2	24.141	1st nozzle bending + Y, - Z
3	31.28	mini-tank
4	39.26	1st engine bending X - Z plane
5	40.28	1st engine bending X - Y plane
6	41.95	mini-tank + nozzle, X - Y plane
7	42.25	mini-tank + nozzle, X - Z plane
8	47.54	1st EAS axial
9	54.38	UTS/mini-tank
10	59.09	mini-tank
11	64.78	1st NSS + mini-tank
12	73.11	2nd NSS

TABLE 18

ENGINE NATURAL FREQUENCIES

CASE 7

n	f_n - Hz	Identification
1	2.074	1st system cantilevered mode, X - Y plane
2	2.322	1st " " " , X - Z plane
3	2.858	mini-tank + engine bending X - Y plane
4	6.897	2nd system cantilevered mode, X - Y plane
5	8.457	1st system axial
6	9.561	mini-tank + engine bending X - Z plane
7	27.076	1st nozzle bending X - Y plane
8	27.422	1st nozzle bending X - Z plane
9	33.507	mini-tank + nozzle
10	34.877	2nd engine bending X - Y plane
11	43.085	mini-tank + 2nd engine bending + Y, + Z
12	43.482	mini-tank + 2nd engine bending + Y, - Z
13	57.358	mini-tank local
14	59.147	NSS + LTS axial
15	63.145	no dominant characteristic
16	69.430	" " "
17	84.448	" " "
18	91.560	" " "
19	93.373	" " "
20	104.4	" " "

TABLE 19

ENGINE NATURAL FREQUENCIES

CASE 8

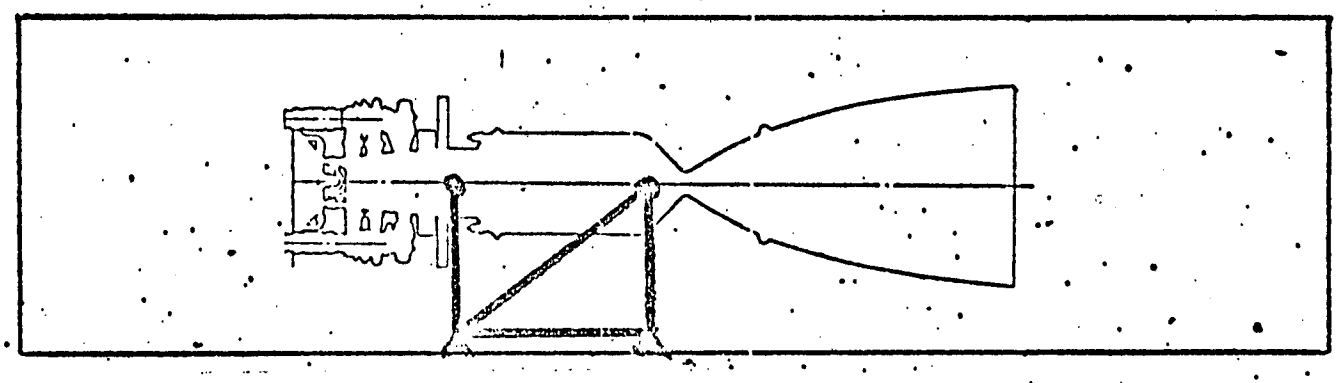
n	f_n - Hz	Identification
1	2.162	1st system cantilevered mode X - Y plane
2	2.369	" " " " X - Z "
3	3.966	mini-tank + engine bending X - Y plane
4	9.291	2nd system cantilevered mode X - Y plane
5	9.931	1st system axial
6	14.144	2nd system cantilevered mode X - Z plane
7	27.835	1st nozzle bending X - Y plane
8	28.592	1st " " X - Z "
9	36.321	mini-tank + engine bending X - Y plane
10	53.025	2nd engine bending + Y, - Z
11	56.869	mini-tank
12	63.558	LTS axial + NSS
13	69.558	1st LTS bending + axial
14	71.857	2nd " " + "
15	77.438	2nd engine bending X - Y plane
16	101.3	no dominant characteristic

APPENDIX A

CASE 1

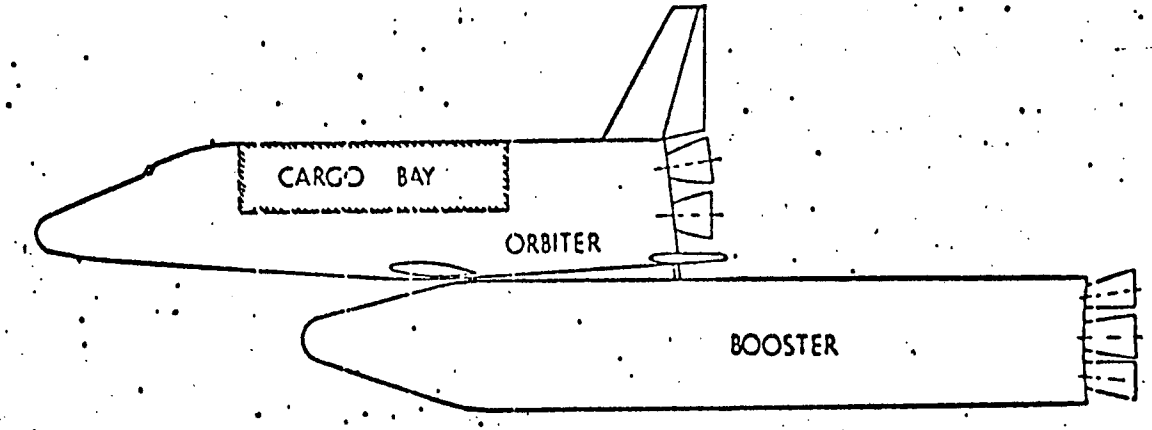
1-a

FIGURE 1



ENGINE ONLY CONFIGURATION

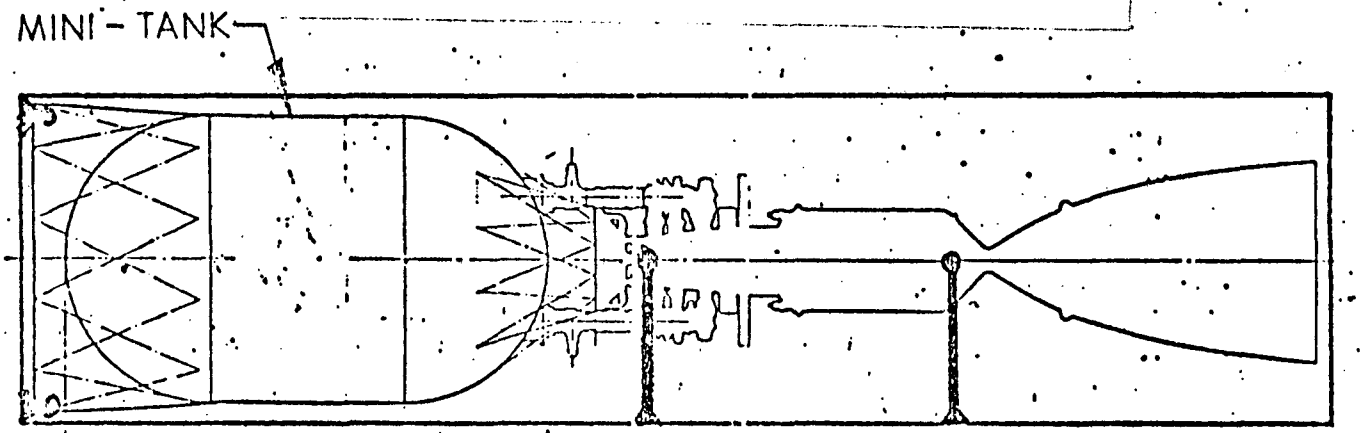
CASES 1 AND 2



EOS

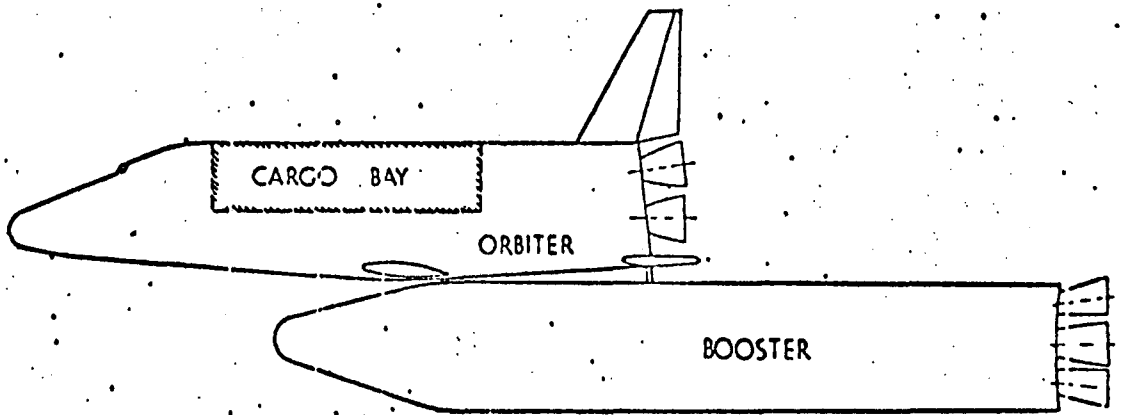
LAUNCH VEHICLE

FIGURE 2



MINI-TANK CONFIGURATION

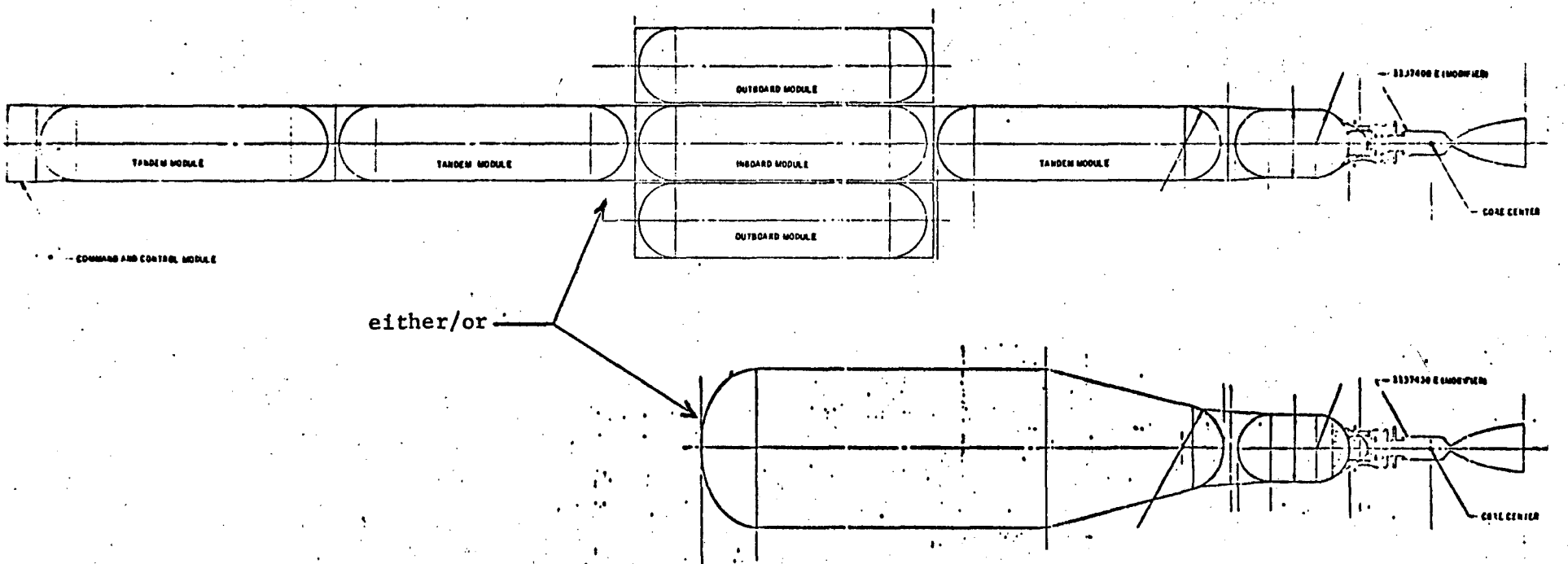
CASES 5 AND 6



EOS

LAUNCH VEHICLE

FIGURE 3



NUCLEAR SPACE OPERATION

MINI-TANK

CASES 7 AND 8

N8120R:72-027

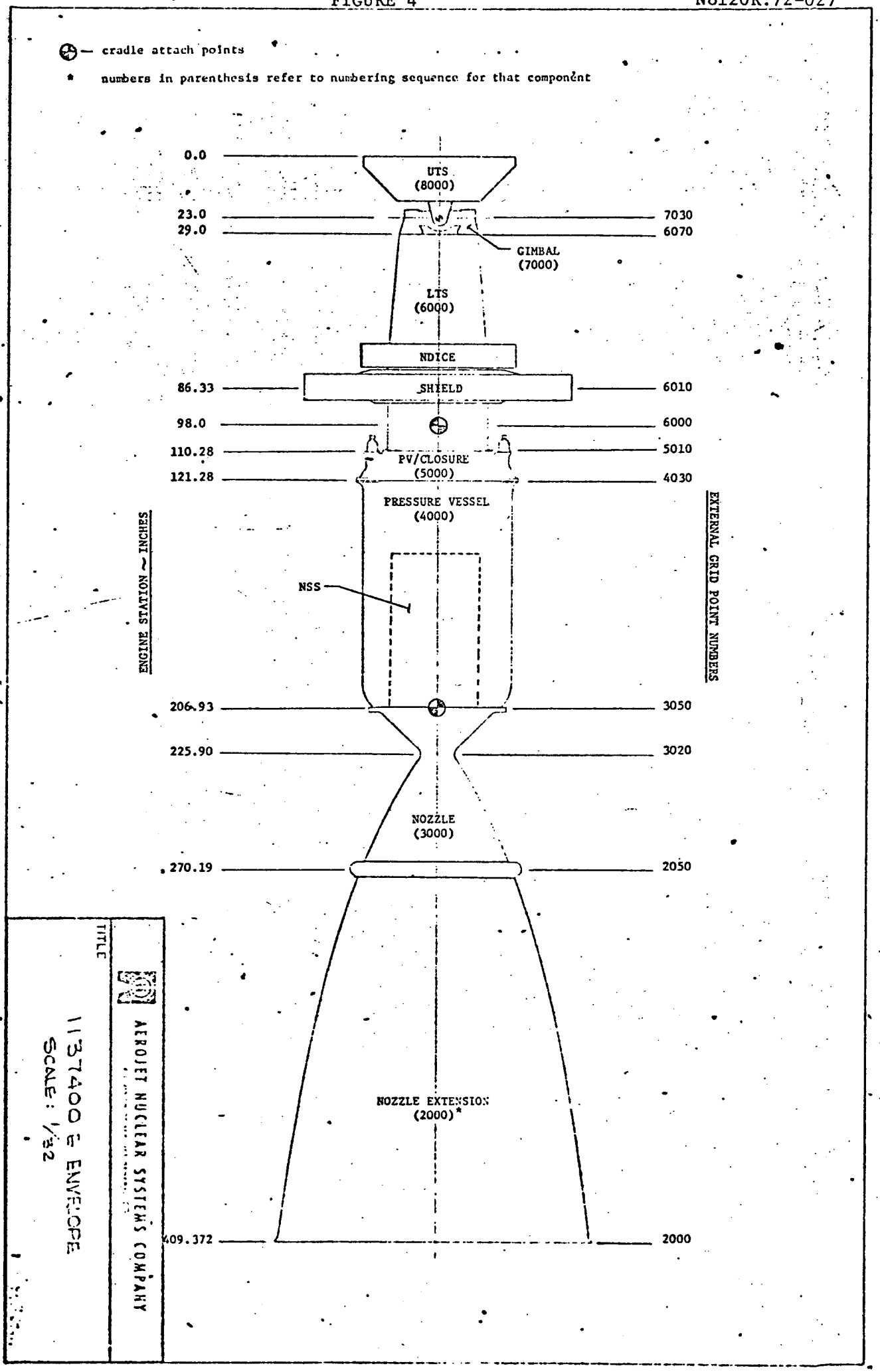
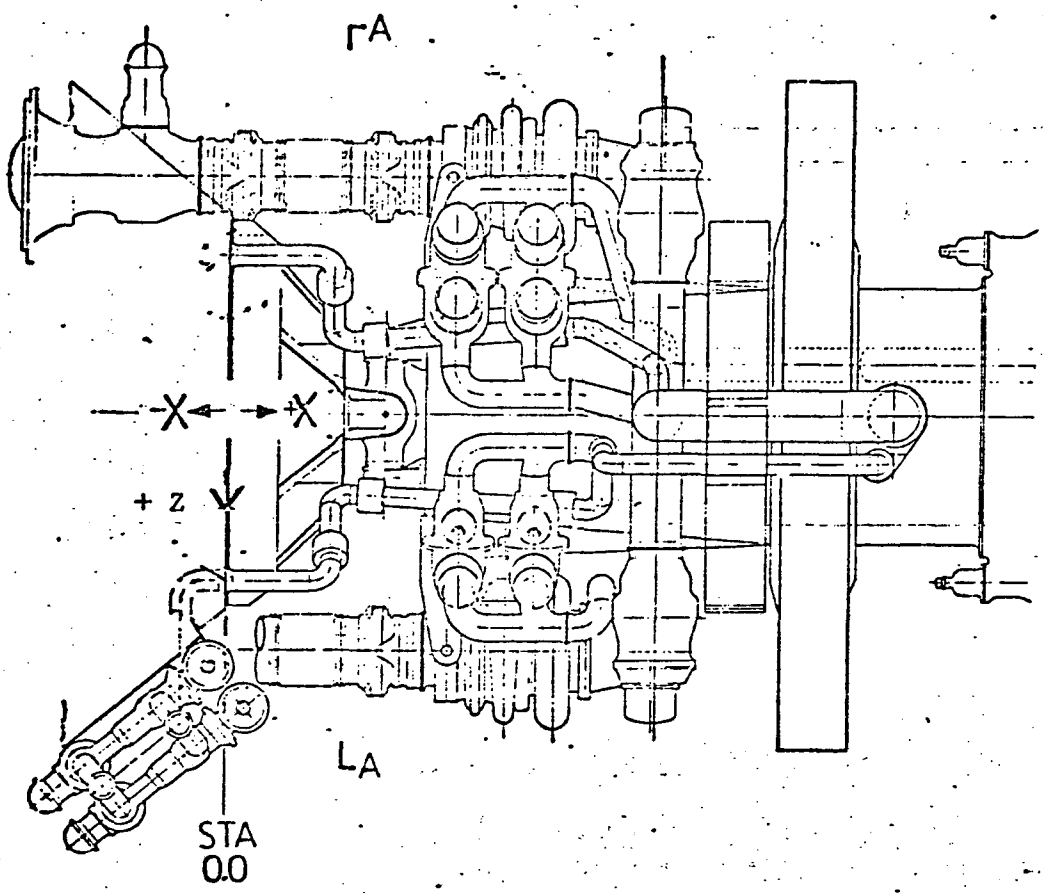

cradle attach points
* numbers in parenthesis refer to numbering sequence for that component
0.0
UTS
(8000)
23.0
29.0
7030
6070
GIMBAL
(7000)
LTS
(6000)
NDICE
86.33
SHIELD
6010
98.0
6000
110.28
5010
PV/CLOSURE
(5000)
121.28
4030
PRESSURE VESSEL
(4000)
NSS
ENGINE STATION ~ INCHES
EXTERNAL GRID POINT NUMBERS
206.93
3050
225.90
3020
NOZZLE
(3000)
270.19
2050
NOZZLE EXTENSION
(2000)*
409.372
2000
TITLE
1137400 E ENVELOPE
SCALE: 1/32
AEROJET NUCLEAR SYSTEMS COMPANY

FIGURE 5

ENGINE COORDINATE SYSTEM

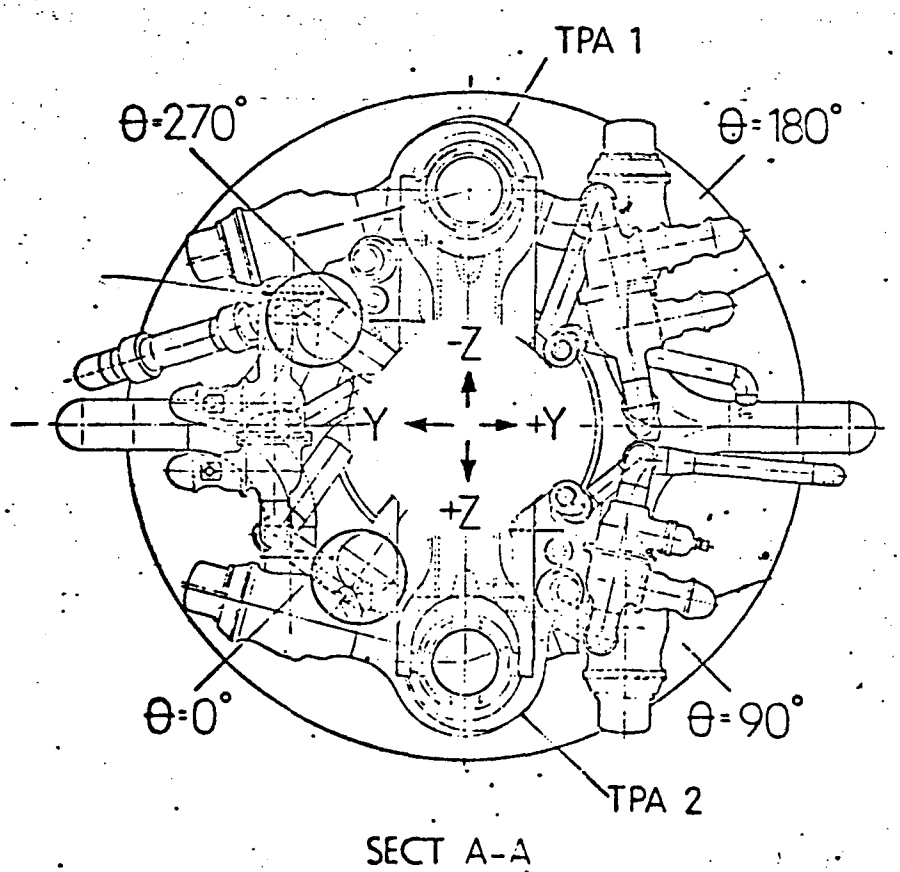


RHS

+X - aft (roll axis)

+Y - st'bd. (pitch axis)

+Z - up (yaw axis)



SECT A-A

FIGURE 6

MINI-TANK GEOMETRY AND NODAL BREAKDOWN

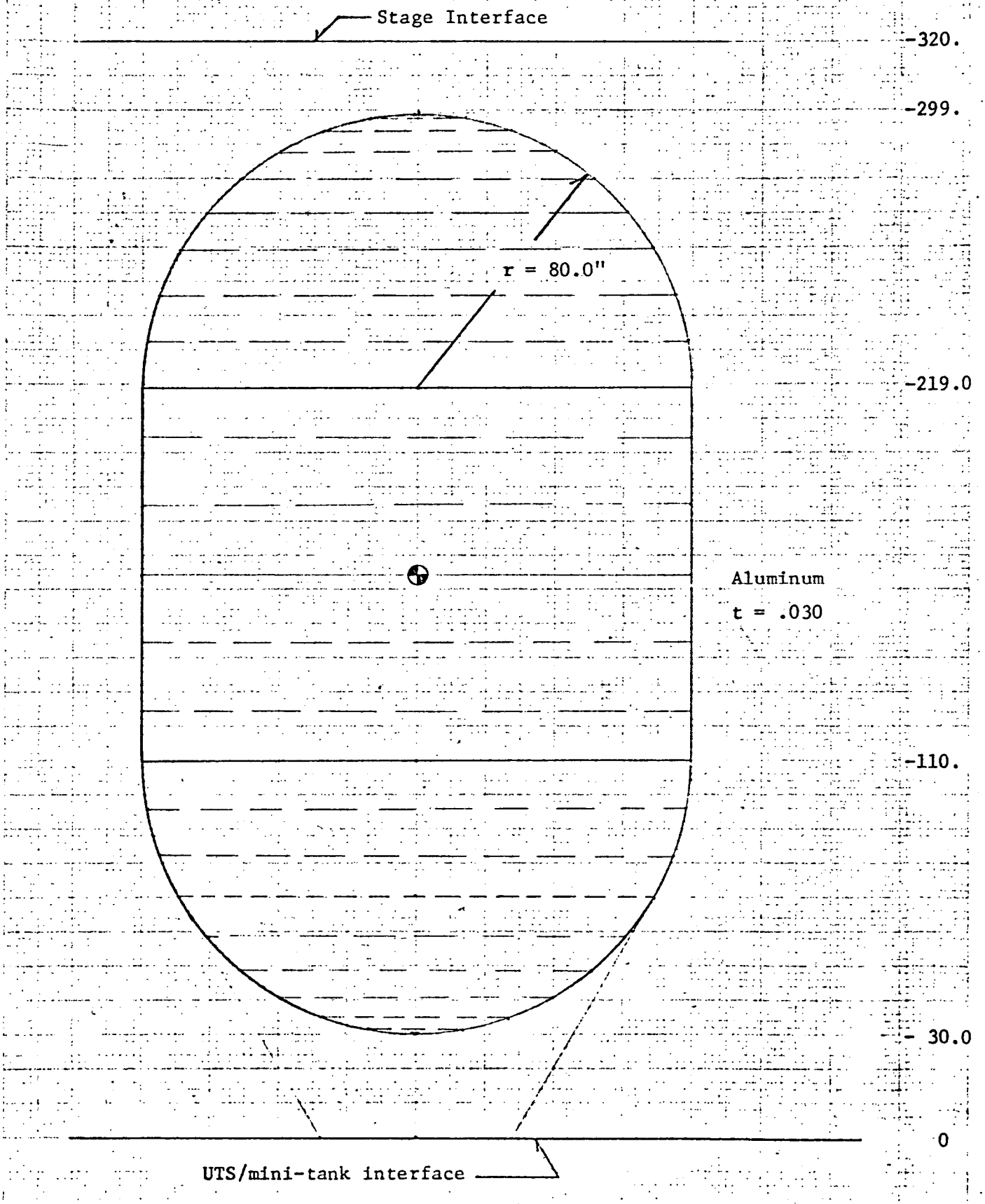


FIGURE 7

NUCLEAR SUBSYSTEM

SCALAR MODEL

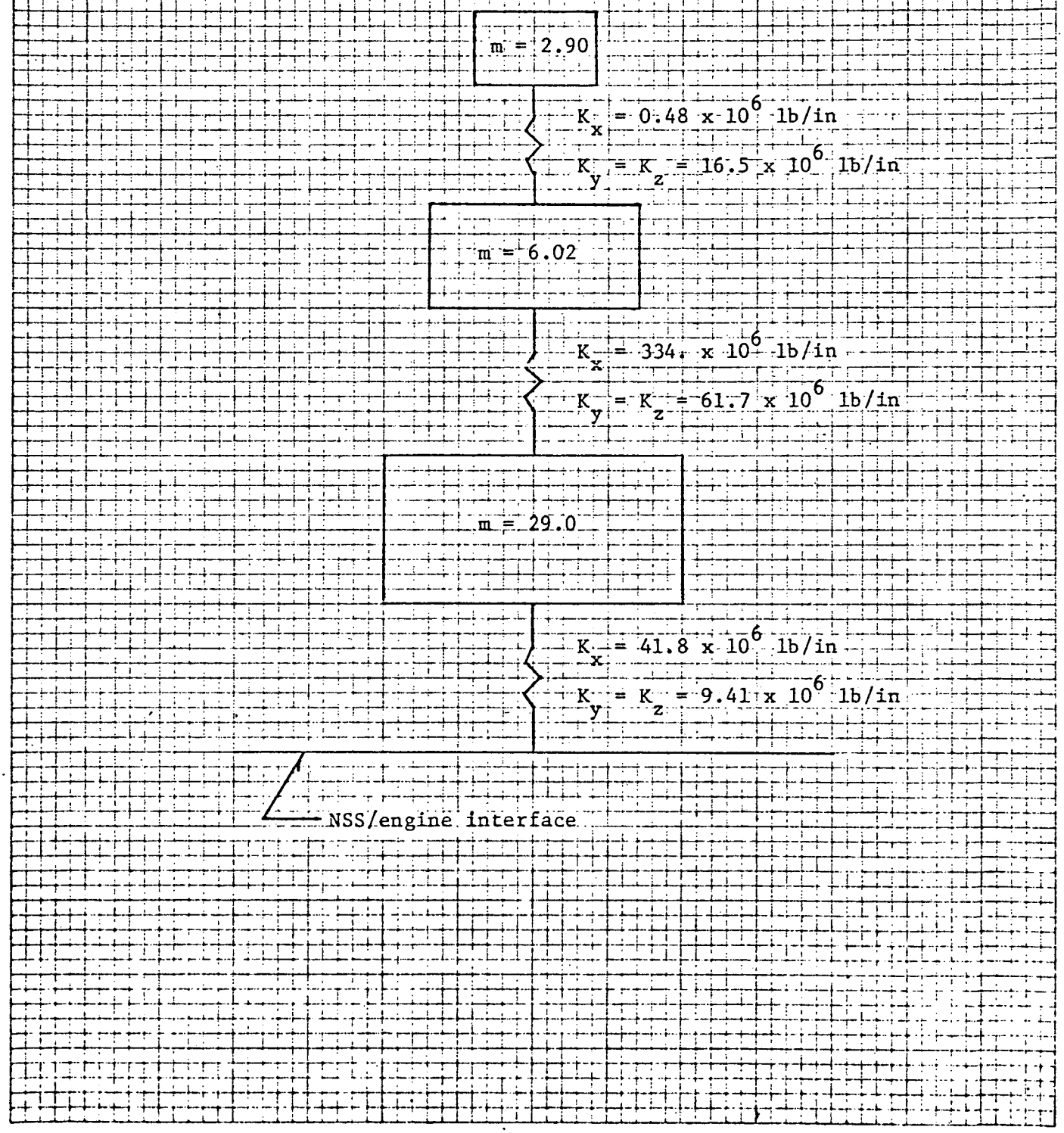
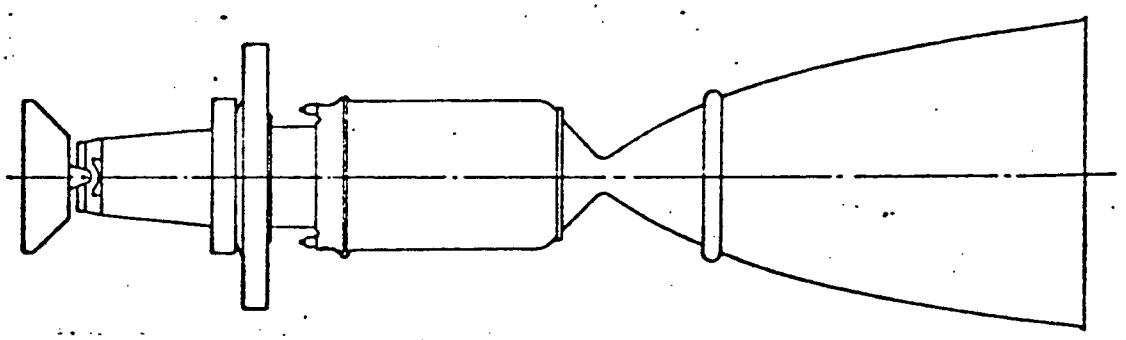


FIGURE 8-1



f = 23.908 Hz

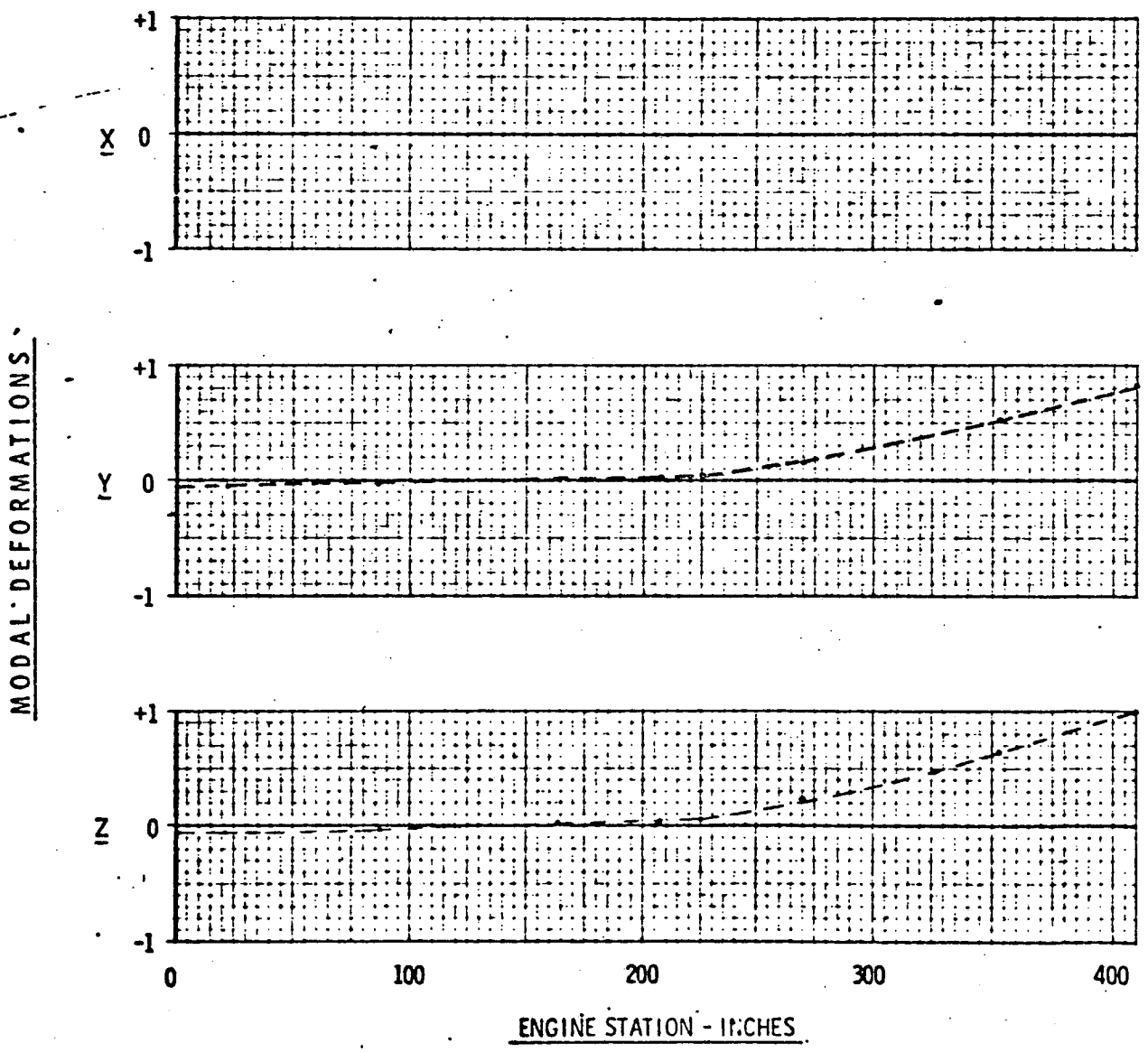
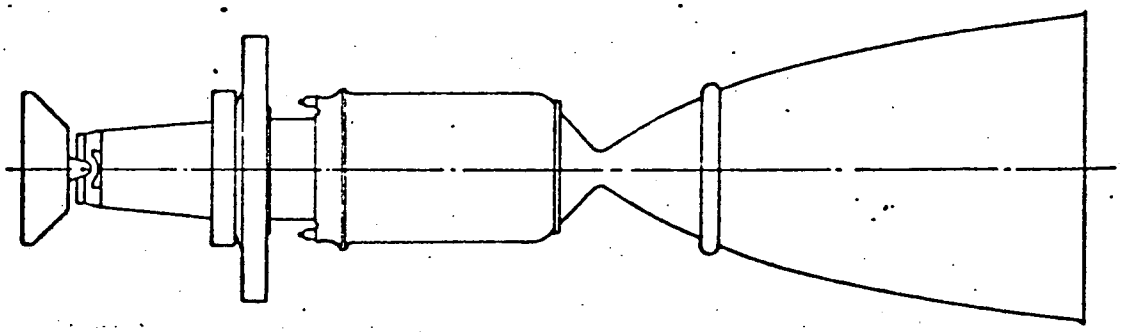


FIGURE 8-2



f = 23.968 Hz

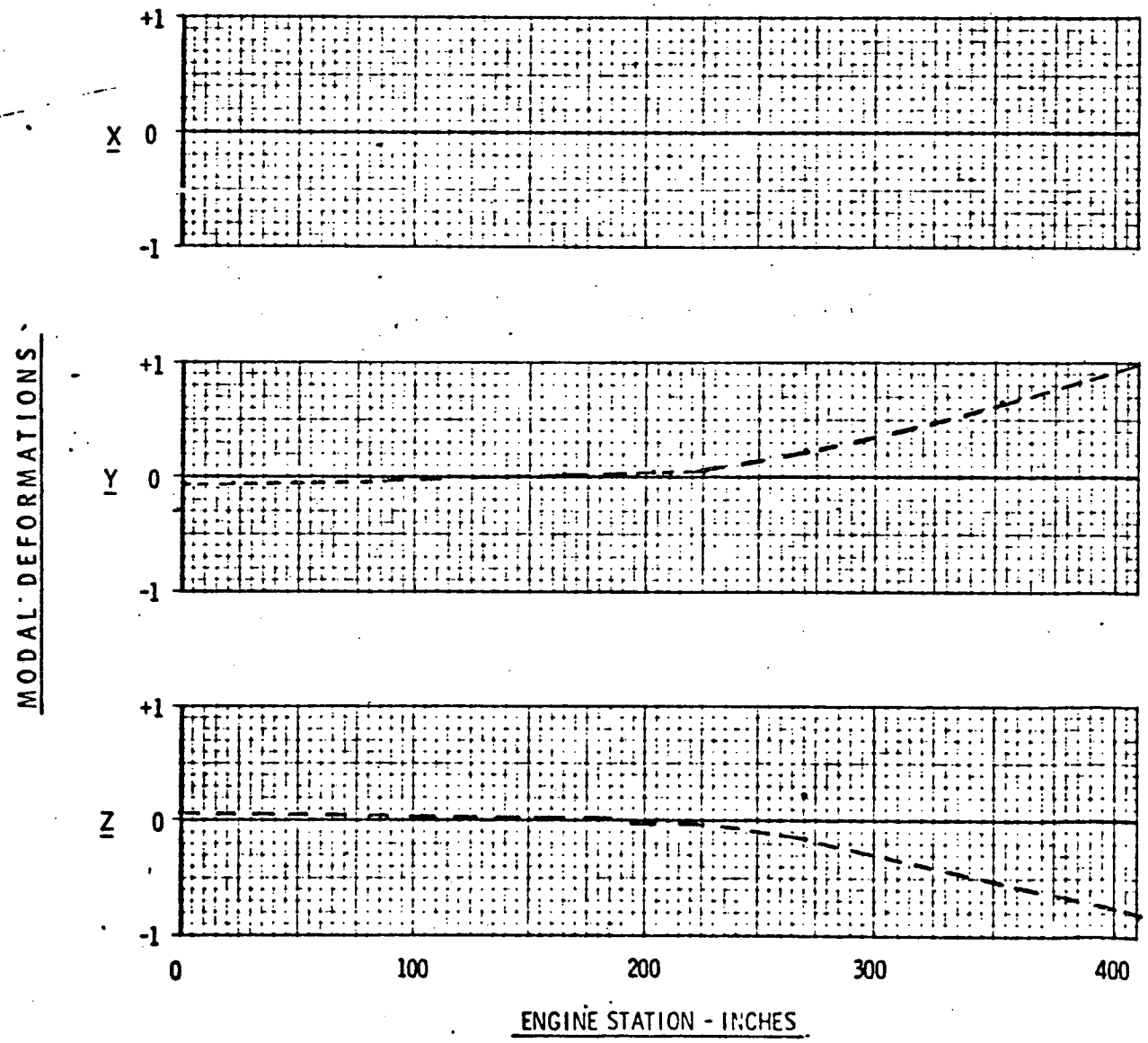
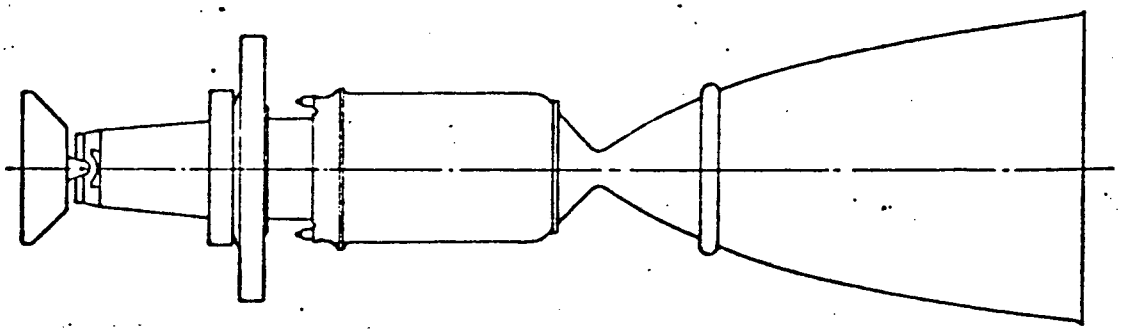


FIGURE 8-3



f = 27.984 Hz

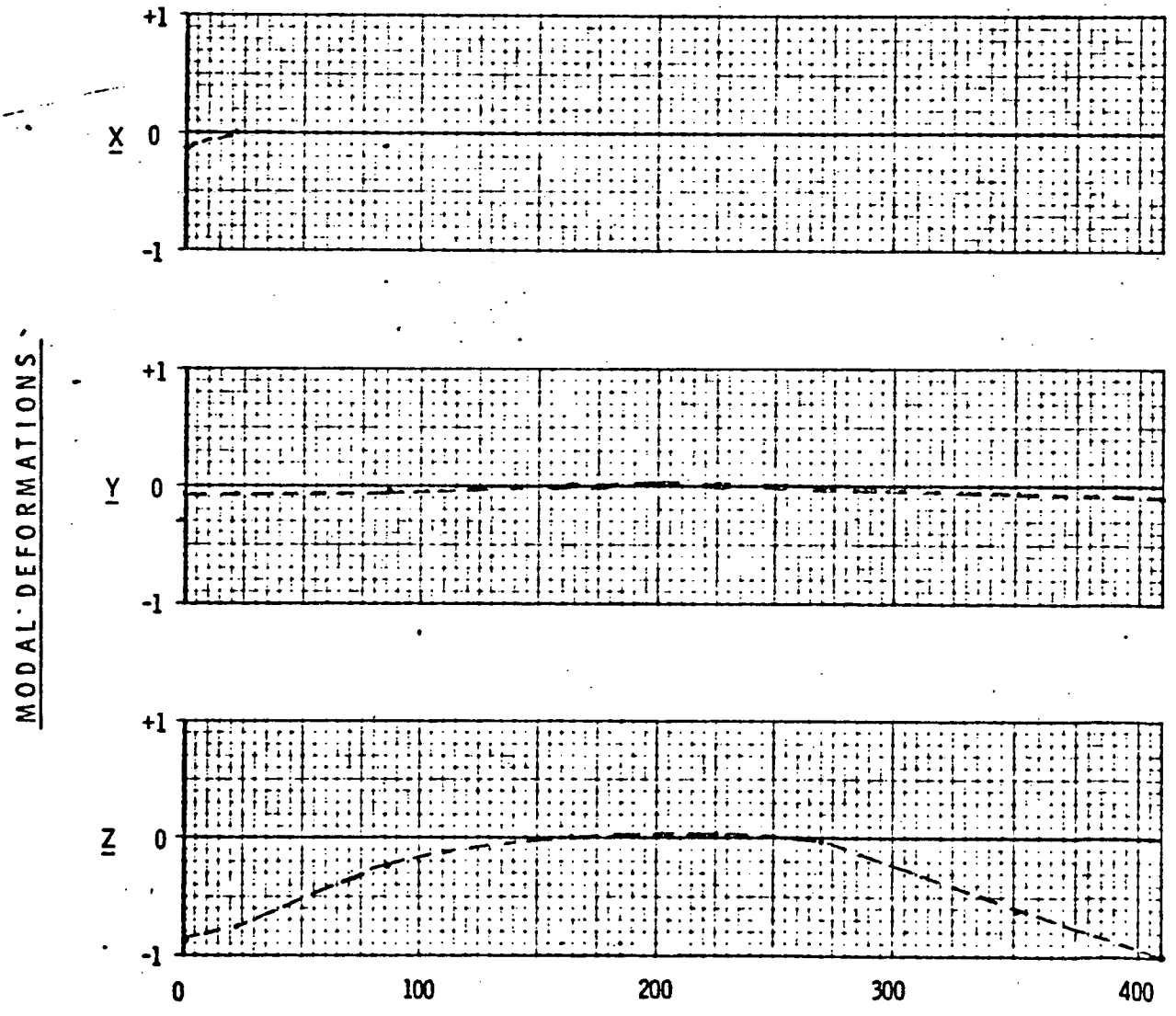
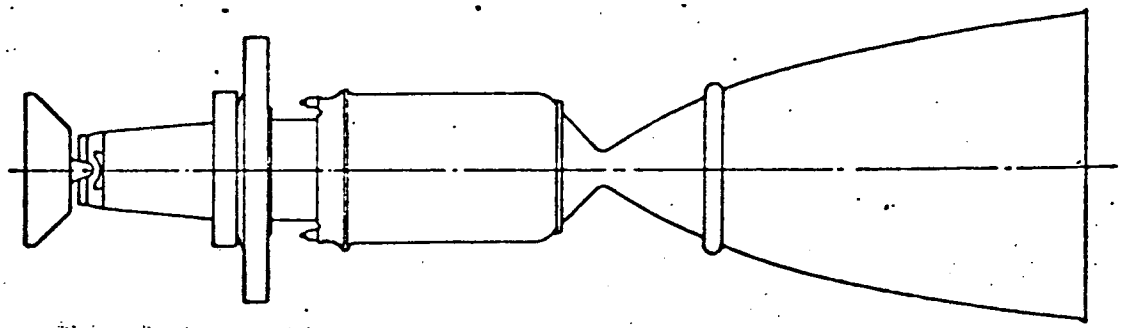


FIGURE 8-4



f = 28.093 Hz

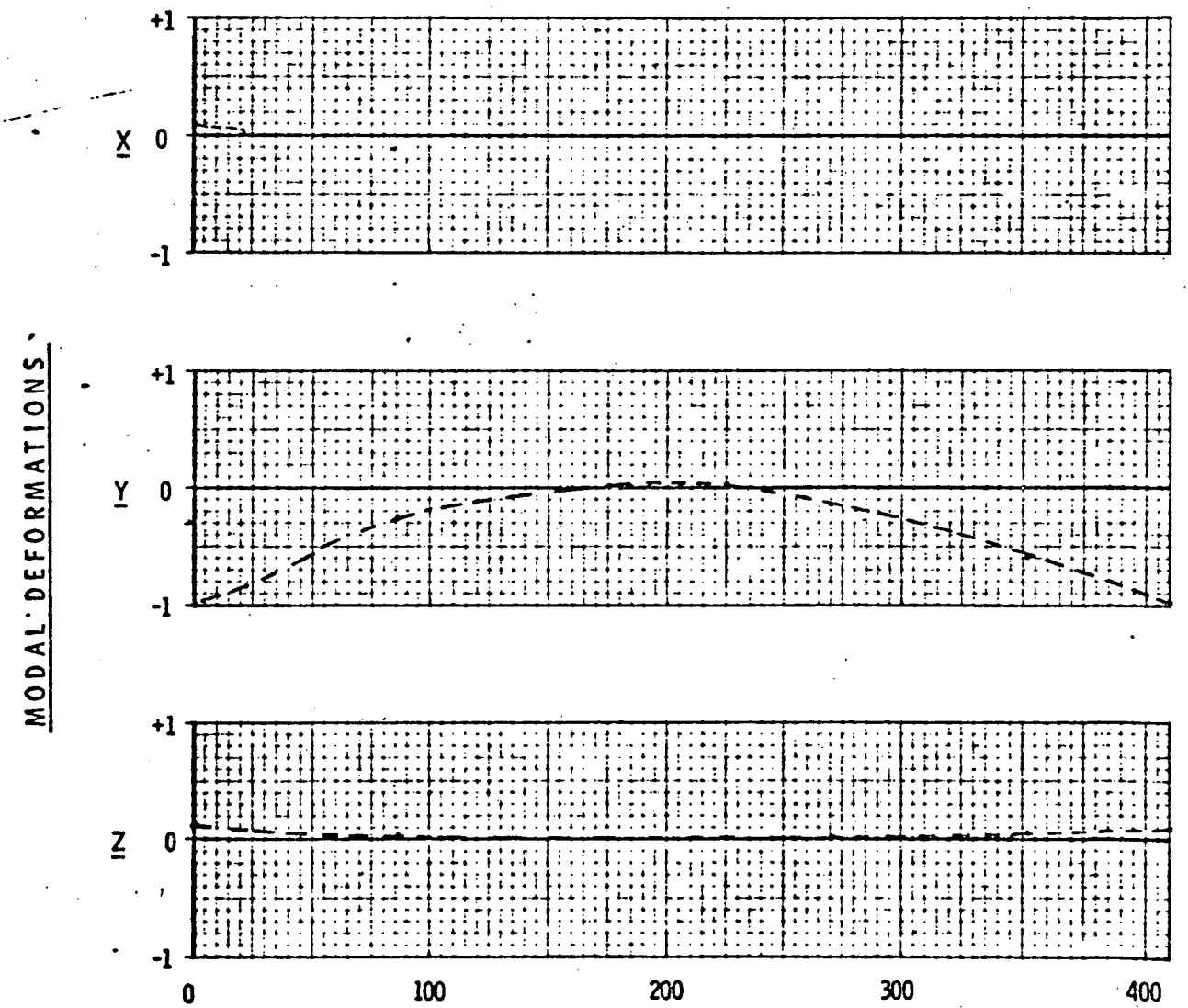
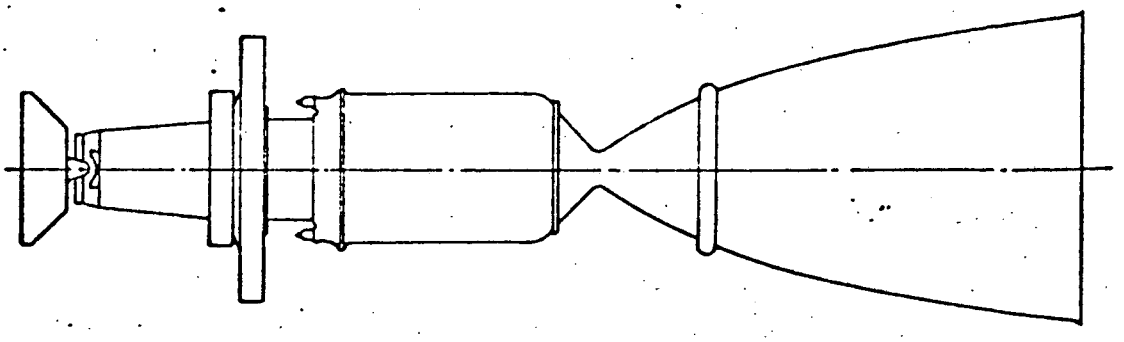


FIGURE 8-5



f = 33.644 Hz

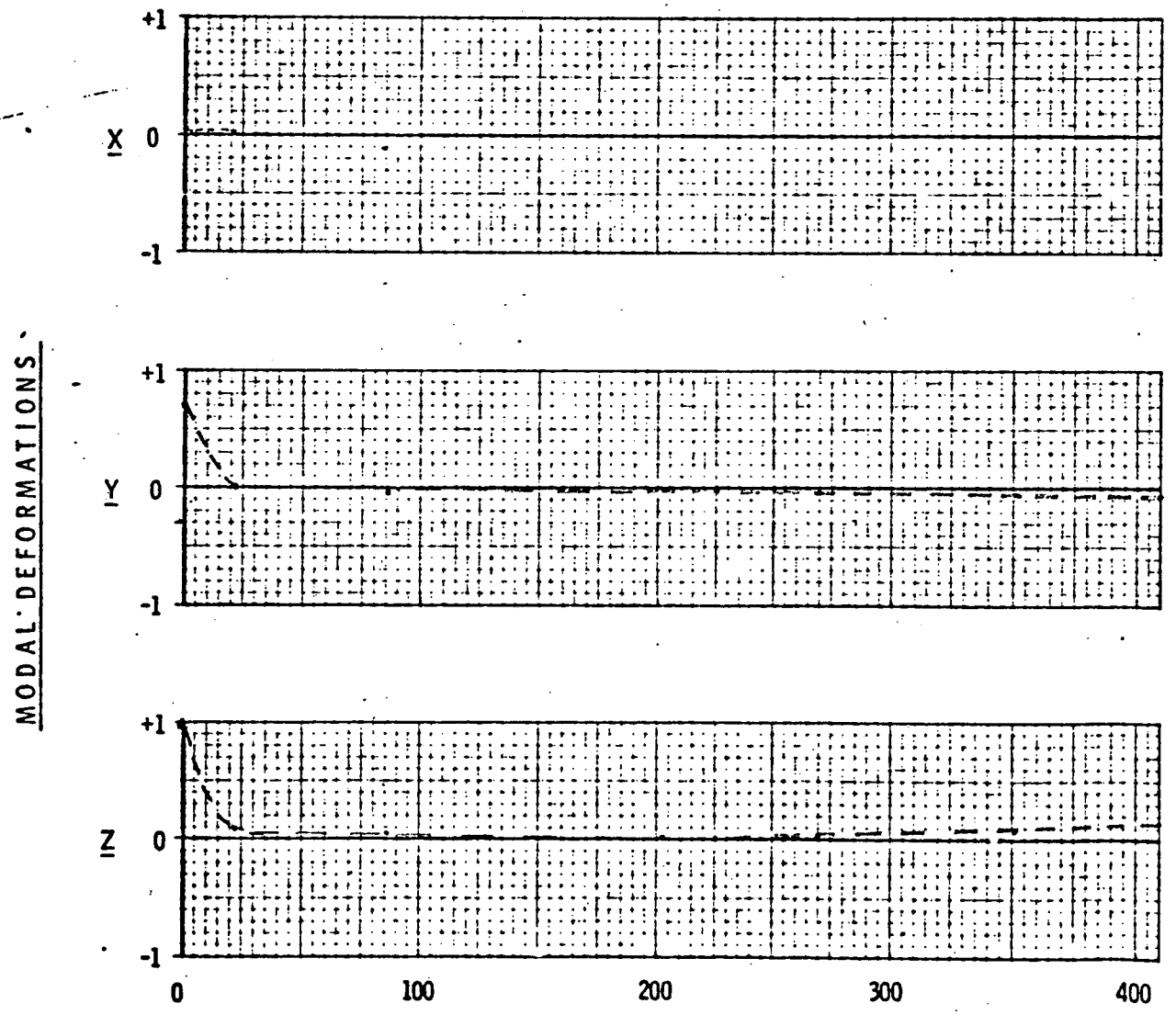
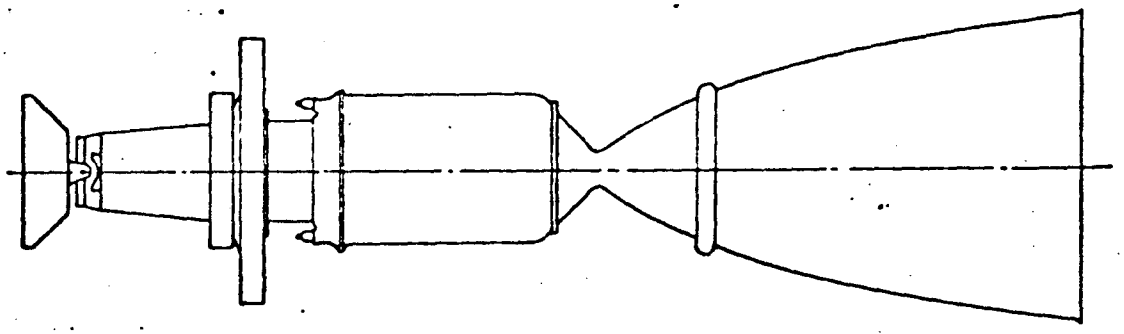


FIGURE 8-6



f = 40.02 Hz

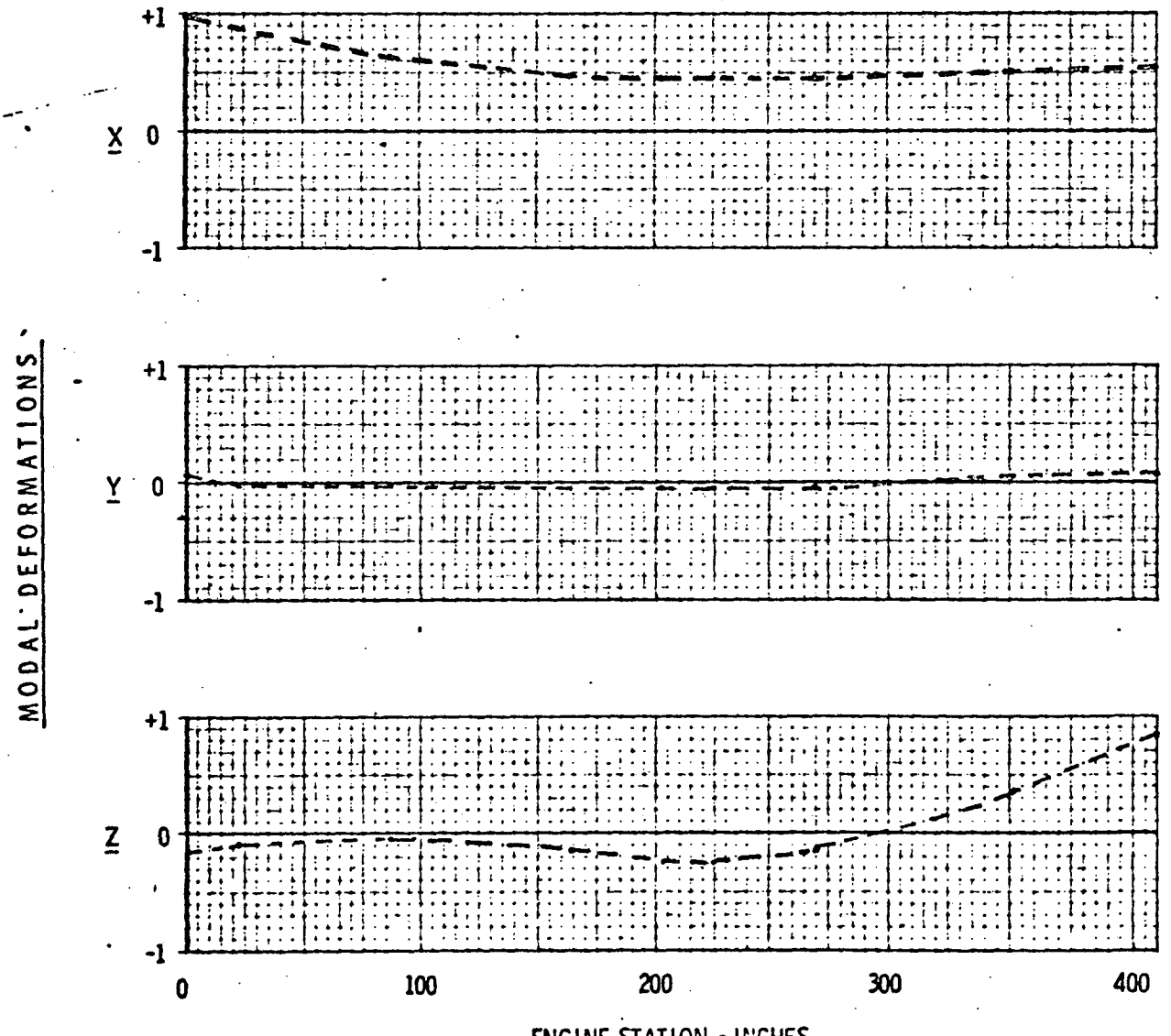
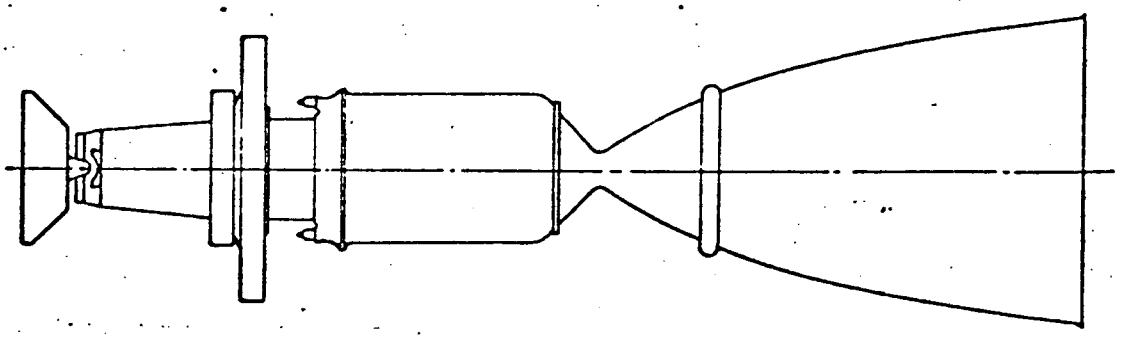


FIGURE 8-7



f = 40.51 Hz

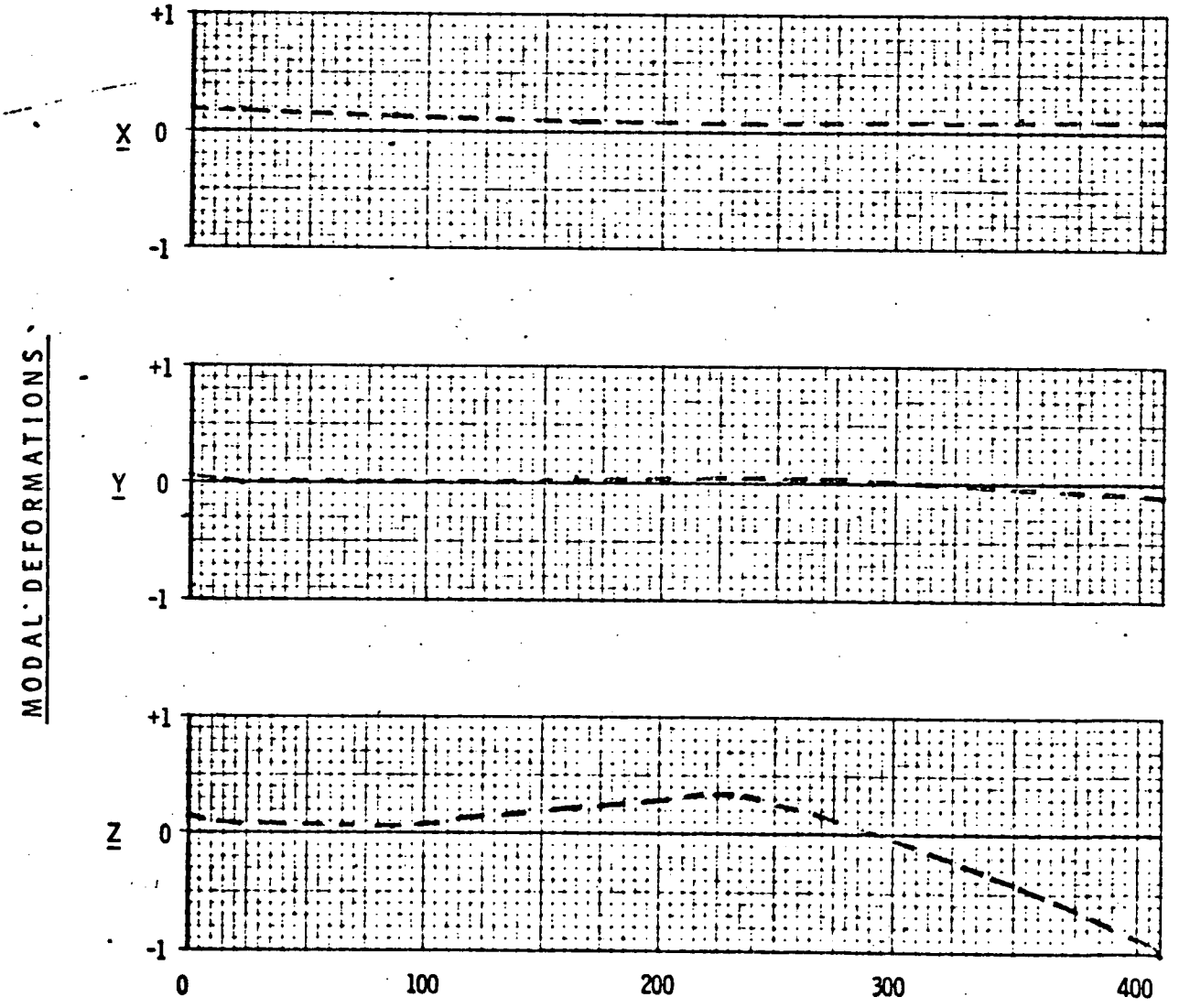
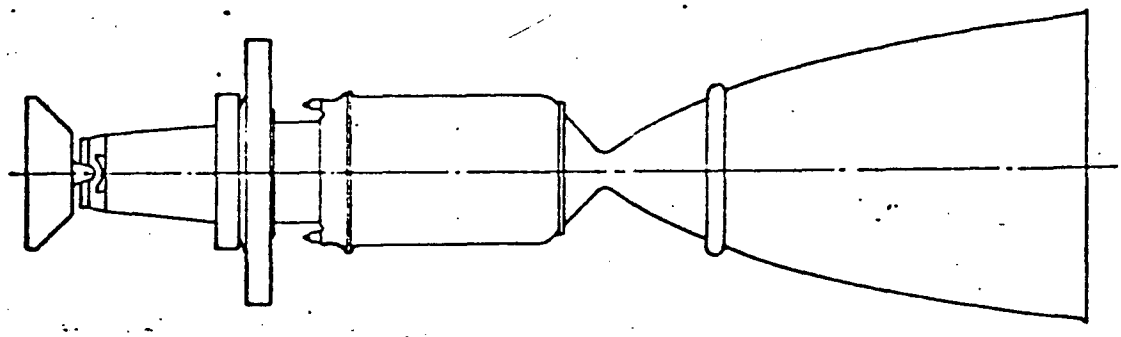


FIGURE 8-8



f = 40.87 Hz

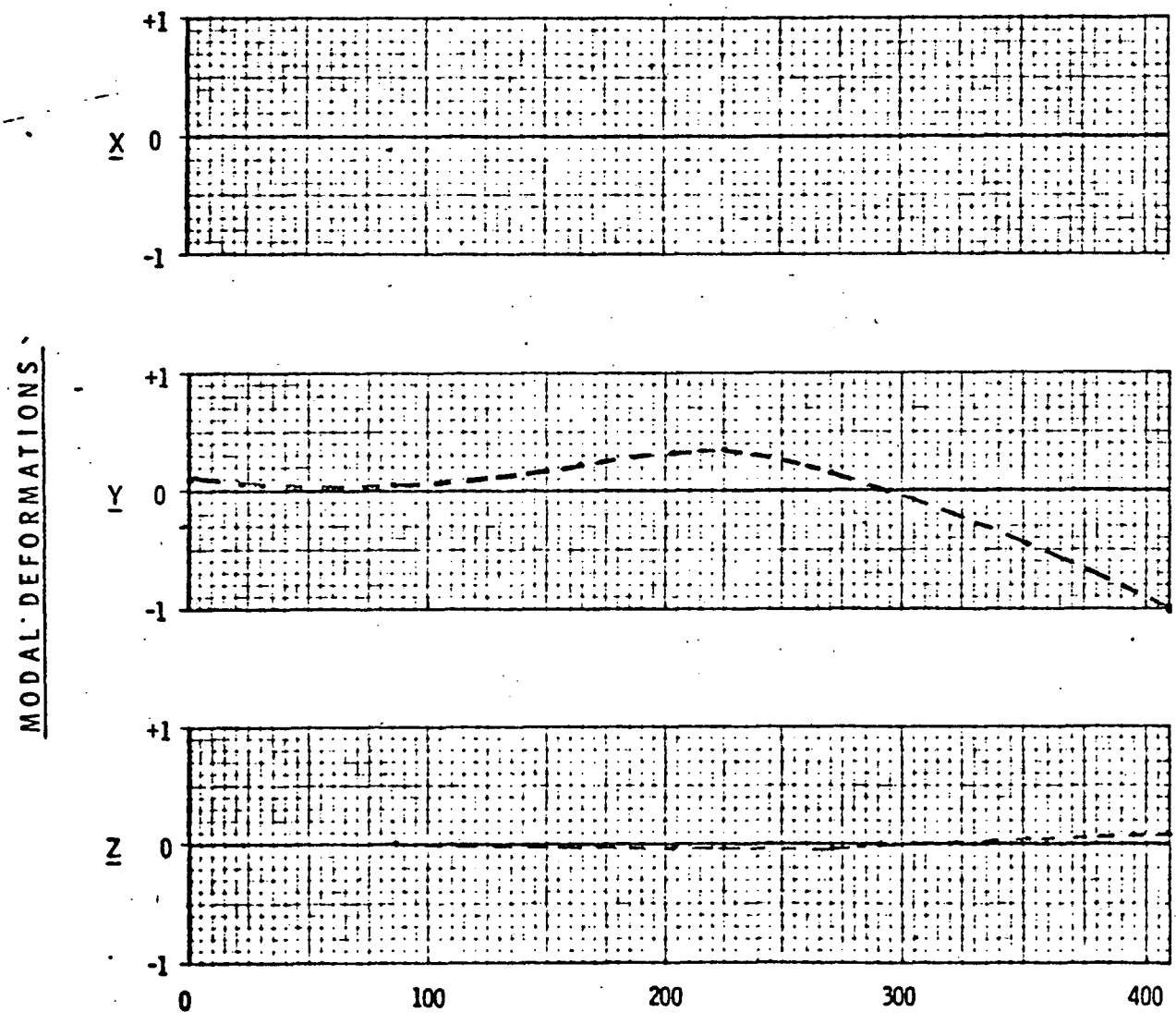
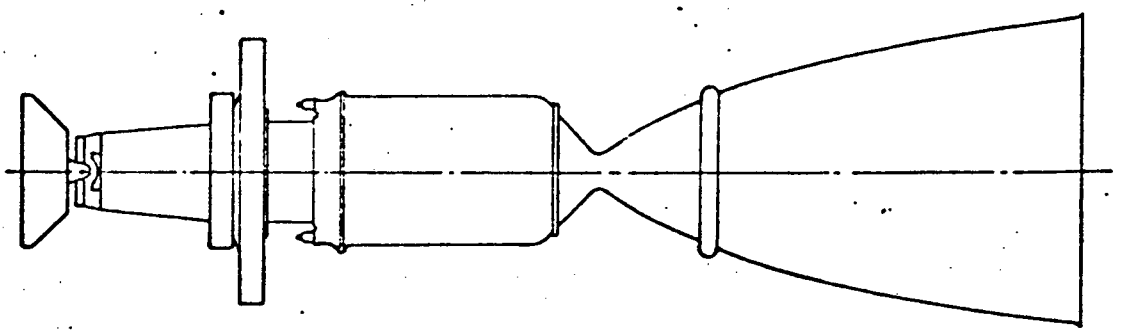


FIGURE 8-9



f = 58.49 Hz

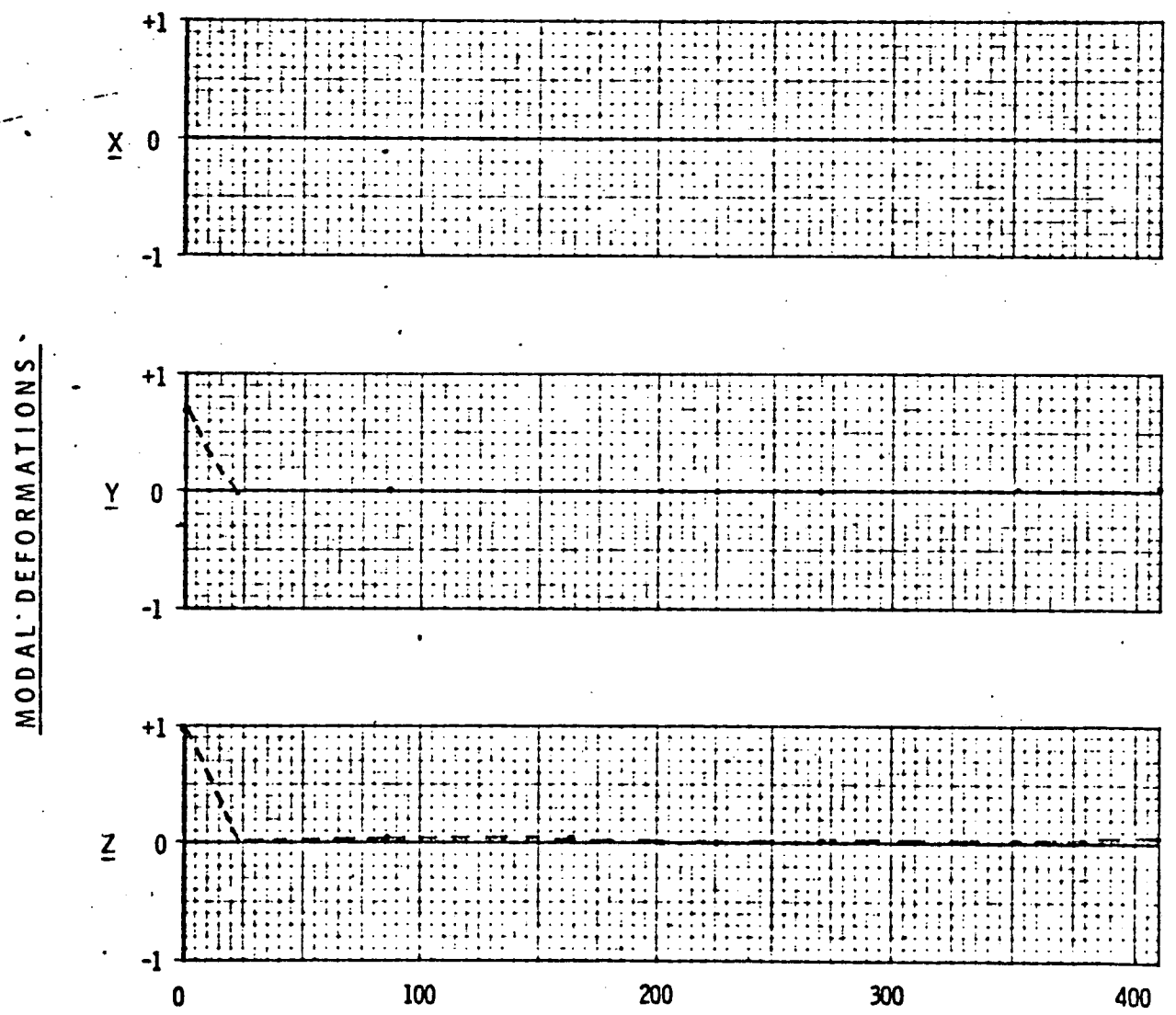
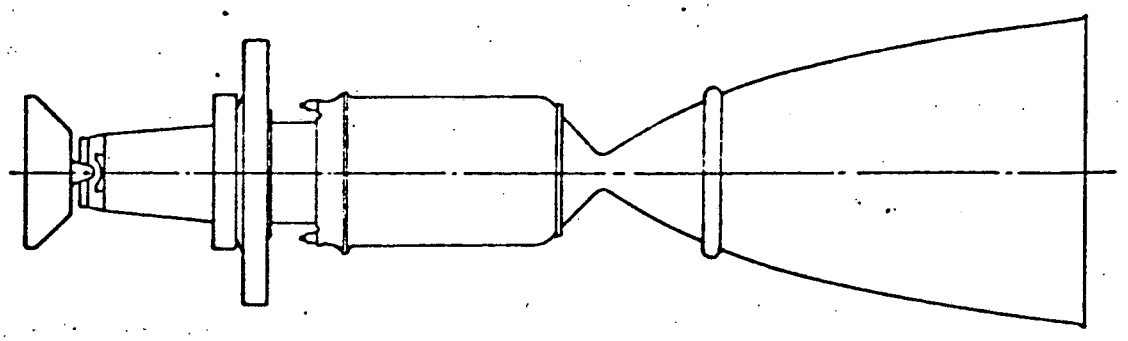


FIGURE 8-10



f = 58.85 Hz

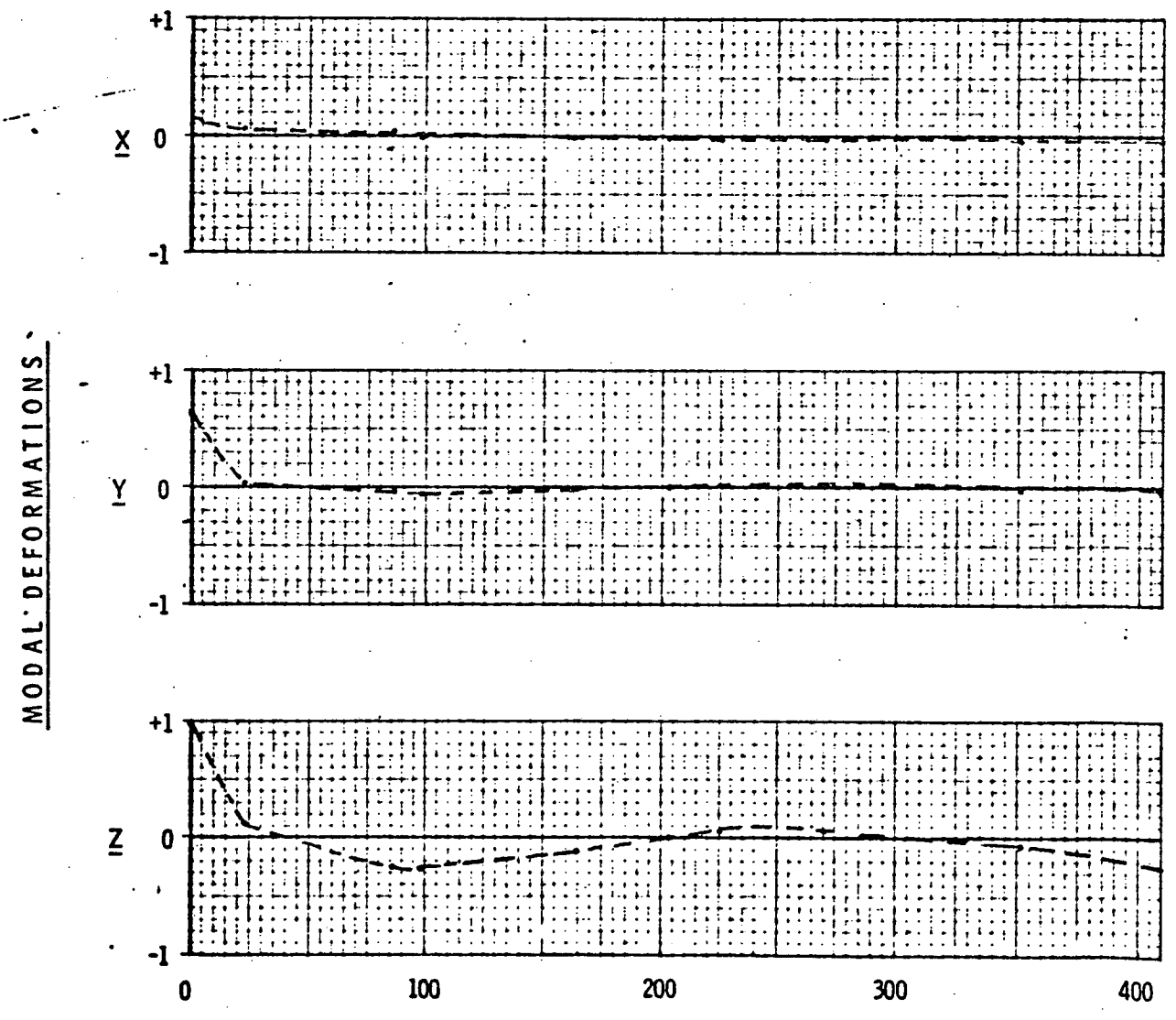
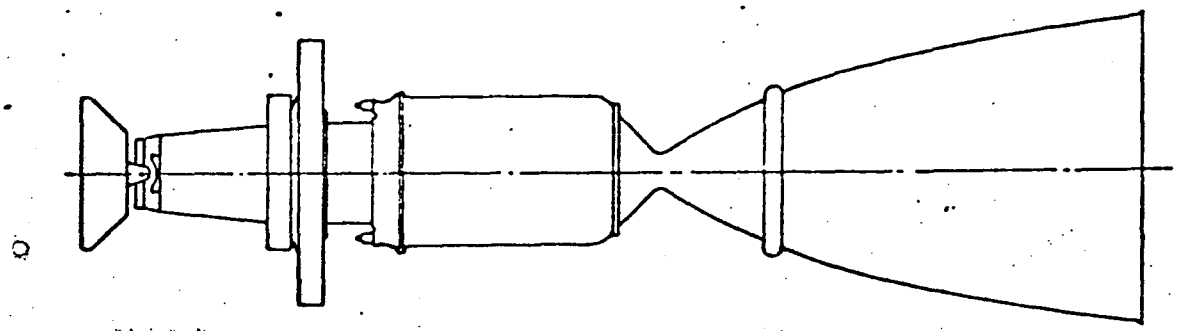


FIGURE 8-11



f = 60.05 Hz

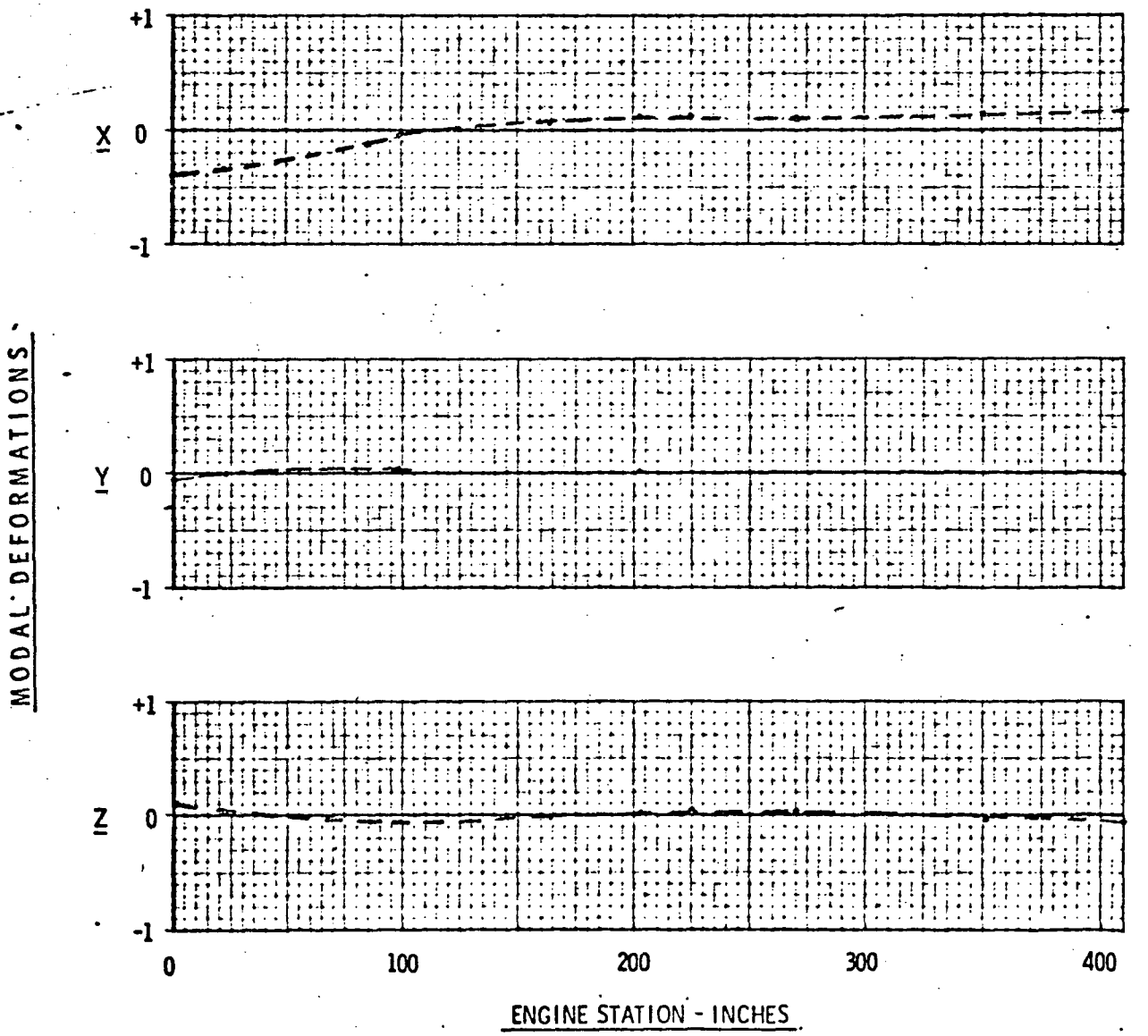
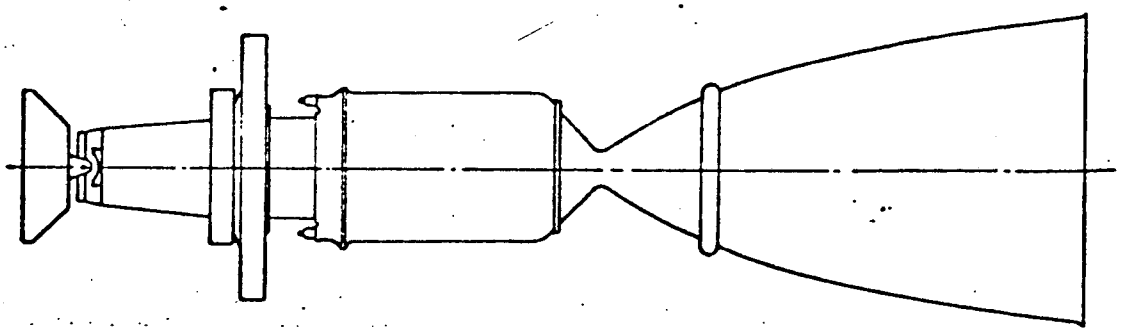


FIGURE 8-12



f = 61.13 Hz

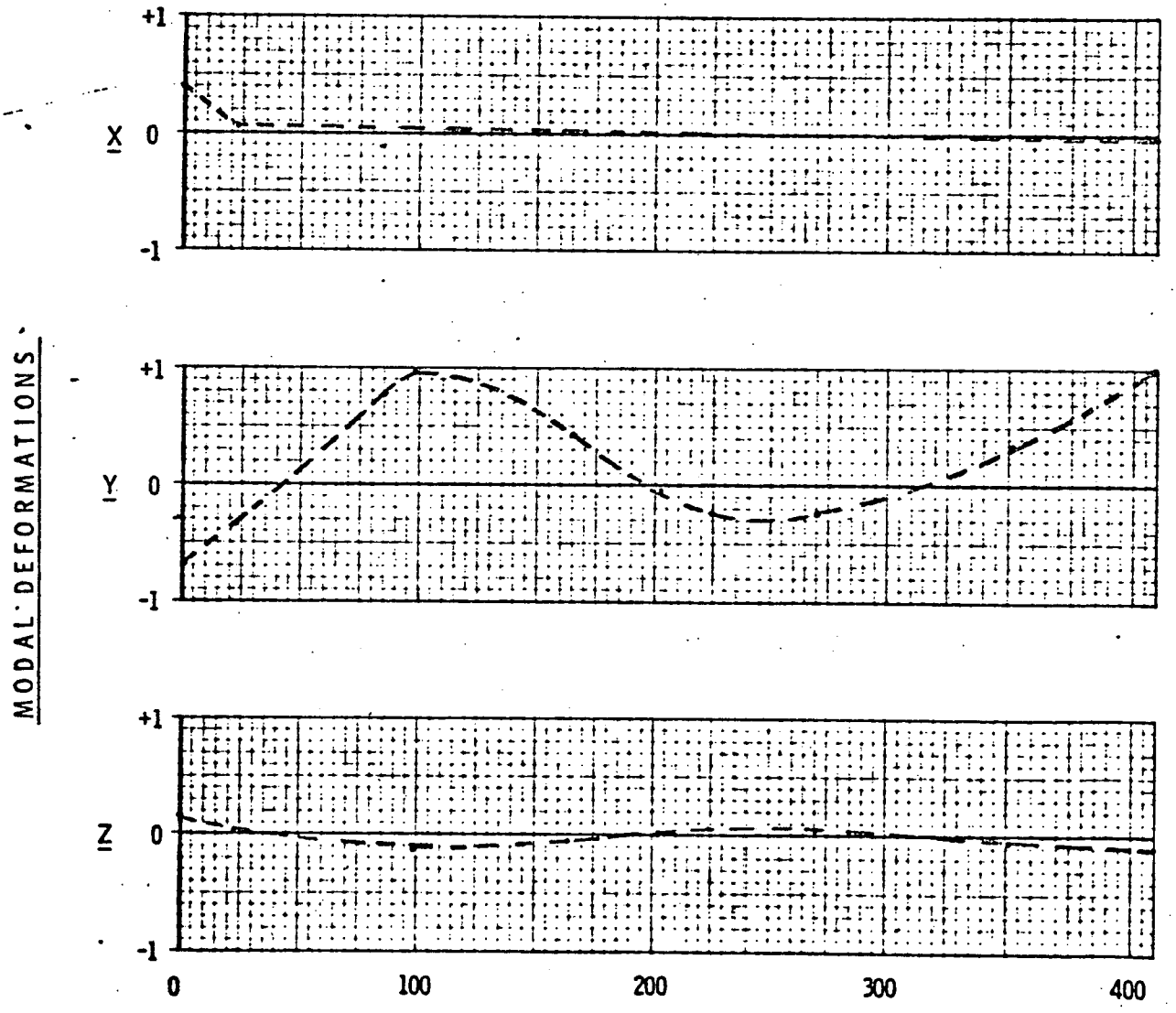
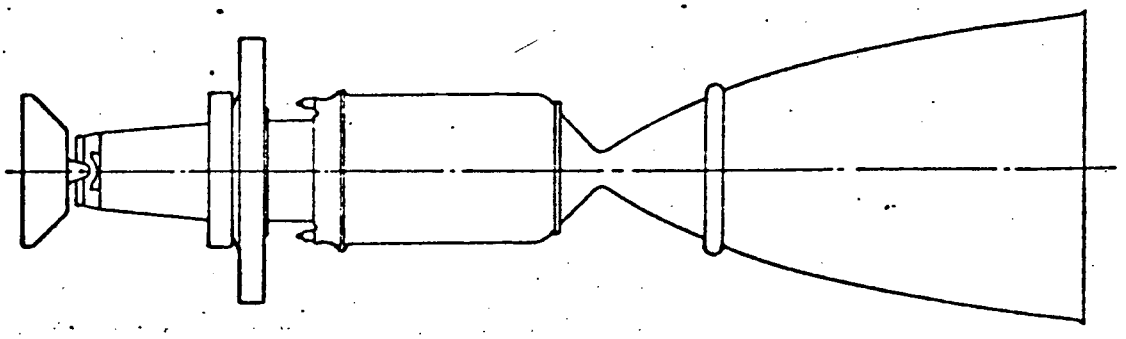
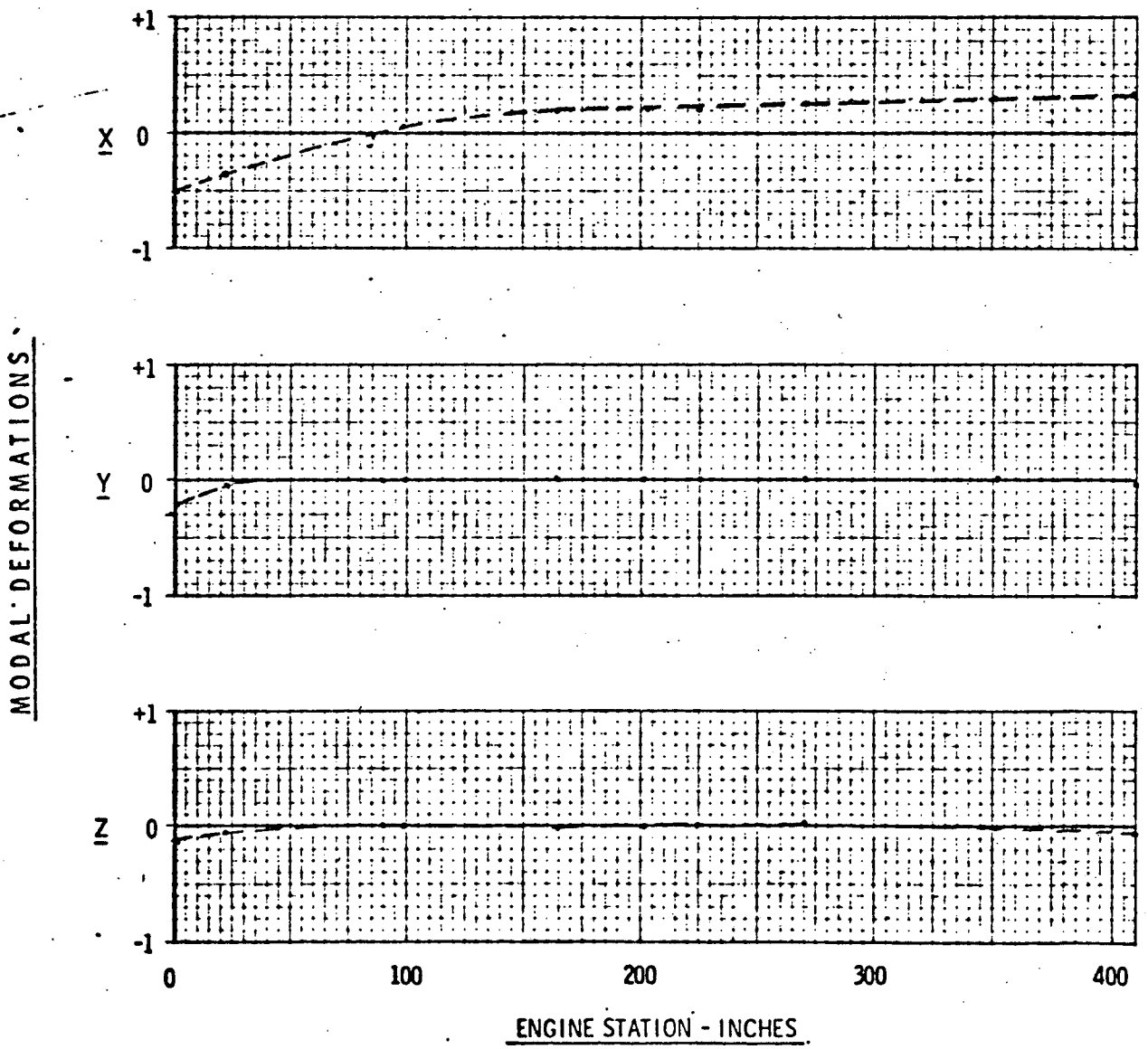


FIGURE 8-13



f = 72.47 Hz



APPENDIX A

LISTINGS OF BASIC BULK DATA DECKS

Page 1

APPENDIX A

CASE 5

Page 2

D ELT EOS/CASE5,1,720114, 42458

```
000001  BARDR                                   1000.0  1000.0  0.0     1
000002  $*************************************************************************
000003  $
000004  $                       COORDINATE SYSTEM DEFINITIONS
000005  $
000006  CORD2C  2               256.1   .0      .0      300.    .0      .0      BC
000007  +BC     300.0   -50.0   0.0
000008  CORD2C  8000            0.0     0.0     0.0     1000.0  0.0     0.0     CYL
000009  +CYL    1000.0  1000.0  0.0
000010  $*************************************************************************
000011  $
000012  $        SUPORT CARD FOR RIGID BODY MODES
000013  $
000014  $*************************************************************************-1
000015  $
000016  $                       EIGENVALUE EXTRACTION
000017  $
000018  EIGR    25      GIV                             25              1.E-6   GIV25
000019  +GIV25  MAX
000020  $*************************************************************************
000021  $
000022  $                       SINGLE-POINT CONSTRAINT SETS
000023  $
000024  SPC1    10      123456  8700
000025  $*************************************************************************
000026  $
000027  $                               MULTI-POINT CONSTRAINTS
000028  $
000029  MPCADD  10      6062    7000    7010    8300    8500    8700
000030  $
000031  $           MPC TPA #2 TO TPA #1
000032  MPC     6062    6062    1       1.0     6061    1       -1.0
000033  MPC     6062    6062    2       1.0     6061    2       -1.0
000034  MPC     6062    6062    3       1.0     6061    3       -1.0
000035  MPC     7000    7000    1       1.0     6070    1       -1.0            7000X
000036  +7000X          6070    5       10.25
000037  MPC     7000    7000    2       1.0     6070    2       -1.0            7000Y
000038  +7000Y          6070    4       -10.25  6070    6       6.0
000039  MPC     7000    7000    3       1.0     6070    3       -1.0            7000Z
000040  +7000Z          6070    5       -6.0
000041  MPC     7000    7000    4       1.0     6070    4       -1.0
000042  MPC     7000    7000    5       1.0     6070    5       -1.0
000043  MPC     7000    7000    6       1.0     6070    6       -1.0
000044  MPC     7010    7010    1       1.0     6070    1       -1.0            7010X
000045  +7010X          6070    5       -10.25
000046  MPC     7010    7010    2       1.0     6070    2       -1.0            7010Y
000047  +7010Y          6070    4       10.25   6070    6       6.0
000048  MPC     7010    7010    3       1.0     6070    3       -1.0            7010Z
000049  +7010Z          6070    5       -6.0
000050  MPC     7010    7010    4       1.0     6070    4       -1.0
000051  MPC     7010    7010    5       1.0     6070    5       -1.0
000052  MPC     7010    7010    6       1.0     6070    6       -1.0
000053  MPC     8300    6080    1       1.0     6050    1       -1.0            6080A
000054  +6080A          6050    5       -20.48  6050    6       -14.34
000055  MPC     8300    6130    1       1.0     6050    1       -1.0            6130A
000056  +6130A          6050    5       14.34   6050    6       -20.48
```

```
000057  MPC     8300    8300    1       1.0     8170    1       -1.0
000058  MPC     8300    8400    1       1.0     8080    1       -1.0
000059  $*************************************************************************
000060  $
000061  $                       OMITTED COORDINATE SET
000062  $
000063  OMIT1   123456  2020    3010    3030    3040    4025    8000    8001    6DOFA
000064  +6DOFA  8002    8005    8010    8020    8021    8022    8160    8030    6DOFB
000065  +6DOFB  8110    8130    8140    4010
000066  OMIT1   456     2000    8170    2040    3000    8210    3020    8180    3DOFA
000067  +3DOFA  8190    4000    8150    4020    8200    4030    5000    6000    3DOFB
000068  +3DOFB  6020    6030    6040    6070    7020    7030    7040    8040    3DOFC
000069  +3DOFC  8050    8060    8070    8080    8090    8100    8120
000070  $*************************************************************************
000071  $
000072  $                           PARAM CARDS
000073  $
000074  PARAM   GRDPNT  0
000075  $*************************************************************************
000076  $
000077  $               GLOBAL AXES FOR PLOT ORIENTATION
000078  $
000079  GRID    1               430.                            123456
000080  GRID    2                       50.                     123456
000081  GRID    3                               50.             123456
000082  GRID    10              420.                            123456
000083  GRID    20                      40.                     123456
000084  GRID    30                              40.             123456
000085  PLOTEL  9001    10      1
000086  PLOTEL  9002    20      2
000087  PLOTEL  9003    30      3
000088  PLOTEL  9010    8120    8005            9011    8005    8025
000089  PLOTEL  9012    8025    8150            9013    8150    8140
000090  PLOTEL  9014    8140    8130            9015    8130    8120
000091  PLOTEL  9020    8200    8050            9021    8050    8040
000092  PLOTEL  9022    8040    8060            9023    8060    8110
000093  PLOTEL  9024    8110    8160            9025    8160    8200
000094  $*************************************************************************
000095  $
000096  $       C O N C E N T R A T E D   M A S S   I T E M S
000097  $
000098  $                       P   F   S
000099  CONM2   9001    2050    2       0.15    28.82   17.6    -2.09
000100  CONM2   9002    5010            .037    -3.36   12.4    7.12
000101  CONM2   9003    5010            1.19    -2.82   .0      .0
000102  CONM2   9004    6060            0.98    2.42    -26.1   .0
000103  CONM2   9005    6050            .86     -1.5    26.5    14.5
000104  CONM2   9006    6050            0.92    4.50    27.5    0.0
000105  $               DESTRUCT SUBSYSTEM
000106  $
000107  $               NOZZLE TO EXTENSION ATTACHMENT
000108  CONM2   2051    2050            .0855                           NEA
000109  +NEA    72.             36.                     36.
000110  $               CORE SUPPORT
000111  CONM2   3051    3050            0.668   -4.93                   CS
000112  +CS     328.            170.                    170.
000113  $               FLANGE
000114  CONM2   3052    3050            1.08    2.07                    FLANGE
000115  +FLANGE 594.            298.                    298.
000116  $               AFT RING
```

```
000117  CONM2   2052    2050            0.40                                    RING
000118  +RING   335.            168.                            168.
000119  $               TORUS
000120  CONM2   2053    2050            0.198   -3.11                           TORUS
000121  +TORUS  181.            91.                             91.
000122  $               NOZZLE TO PV BOLTS
000123  CONM2   3057    3050            .096    1.07                            BOLTS
000124  +BOLTS  51.15           25.65                           25.65
000125  $               CONTROL DRUM ACTUATORS (18)
000126  CONM2   5011    5010    8000    .0344   24.5    10.
000127  CONM2   5012    5010    8000    .0344   24.5    30.
000128  CONM2   5013    5010    8000    .0344   24.5    50.
000129  CONM2   5014    5010    8000    .0344   24.5    70.
000130  CONM2   5015    5010    8000    .0344   24.50   90.
000131  CONM2   5016    5010    8000    .0344   24.50   110.
000132  CONM2   5017    5010    8000    .0344   24.50   130.
000133  CONM2   5018    5010    8000    .0344   24.50   150.
000134  CONM2   5019    5010    8000    .0344   24.50   170.
000135  CONM2   50110   5010    8000    .0344   24.50   190.
000136  CONM2   50111   5010    8000    .0344   24.50   210.
000137  CONM2   50112   5010    8000    .0344   24.50   230.
000138  CONM2   50113   5010    8000    .0344   24.50   250.
000139  CONM2   50114   5010    8000    .0344   24.50   270.
000140  CONM2   50115   5010    8000    .0344   24.50   290.
000141  CONM2   50116   5010    8000    .0344   24.50   310.
000142  CONM2   50117   5010    8000    .0344   24.50   330.
000143  CONM2   50118   5010    8000    .0344   24.50   350.
000144  $               SHIELD
000145  CONM2   6010    6010            25.06   1.67                            SHIELD
000146  +SHIELD 29743.          14957.                          14957.
000147  $               NOICE
000148  CONM2   6021    6020            1.55
000149  $                               ACTUATORS
000150  CONM2   60801   6080            0.24
000151  CONM2   61301   6130            0.24
000152  CONM2   83001   8300            0.24
000153  CONM2   84001   8400            0.24
000154  $                               SIMPLE NSS
000155  CONM2   4001    4001            29.
000156  CONM2   4002    4002            6.02
000157  CONM2   4003    4003            2.90
000158  $*************************************************************************
000159  $
000160  $       COMPONENT NO. 2         NOZZLE EXTENSION
000161  $
000162  CBAR    2020    2020    2020    2000
000163  CBAR    2040    2040    2040    2020
000164  CBAR    2050    2050    2050    2040
000165  GRID    2000            409.372
000166  GRID    2020            351.543
000167  GRID    2040            296.865
000168  GRID    2050            270.190
000169  MAT1    100     1.7E6   0.70E6          1.355E-4
000170  PBAR    2020    100     40.865  55550.  55550.  111100. .00445
000171  PBAR    2040    100     33.253  30250.  30250.  60500.  .00445
000172  PBAR    2050    100     50.047  25400.  25400.  50800.  .00445
000173  $*************************************************************************
000174  $
000175  $       COMPONENT NO. 3         NOZZLE
000176  $
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000177  CBAR    3000    3000    3000    2050
000178  CBAR    3010    3010    3010    3000
000179  CBAR    3020    3020    3020    3010
000180  CBAR    3030    3030    3030    3020
000181  CBAR    3040    3040    3040    3030
000182  CBAR    3050    3050    3050    3040
000183  GRID    3000            254.218
000184  GRID    3010            233.25
000185  GRID    3020            225.90
000186  GRID    3030            220.491
000187  GRID    3040            213.236
000188  GRID    3050            206.93
000189  MAT1    347     29.3E6  11.4E6          7.394E-4
000190  PBAR    3000    347     11.5    3414.   3414.   6828.   .007
000191  PBAR    3010    347     32.3    4371.   4371.   8742.   .007
000192  PBAR    3020    347     16.3    567.    567.    1133.   .007
000193  PBAR    3030    347     13.7    333.    333.    666.    .007
000194  PBAR    3040    347     25.2    2070.   2070.   4140.   .007
000195  PBAR    3050    347     82.2    16170.  16170.  32340.  .007
000196  $*************************************************************************
000197  $
000198  $       NUCLEAR SUBSYSTEM       SIMPLE MODEL
000199  $
000200  CELAS2  40011   41.8E6  4001    1       3050    1
000201  CELAS2  40012   9.41E6  4001    2       3050    2
000202  CELAS2  40013   9.41E6  4001    3       3050    3
000203  CELAS2  40021   334.E6  4002    1       4001    1
000204  CELAS2  40022   61.7E6  4002    2       4001    2
000205  CELAS2  40023   61.7E6  4002    3       4001    3
000206  CELAS2  40031   0.48E6  4003    1       4002    1
000207  CELAS2  40032   16.5E6  4003    2       4002    2
000208  CELAS2  40033   16.5E6  4003    3       4002    3
000209  GRID    4001            170.0                           456
000210  GRID    4002            129.0                           456
000211  GRID    4003            124.0                           456
000212  $*************************************************************************
000213  $
000214  $       COMPONENT NO. 4         PRESSURE VESSEL
000215  $
000216  CBAR    4000    4000    4000    3050
000217  CBAR    4010    4000    4010    4000
000218  CBAR    4020    4000    4020    4010
000219  CBAR    4025    4000    4025    4020
000220  CBAR    4030    4000    4030    4025
000221  GRID    4000            185.5175
000222  GRID    4010            164.105
000223  GRID    4020            142.6925
000224  GRID    4025            124.67
000225  GRID    4030            121.28
000226  MAT1    7075    10.3E6  3.9E6           2.616E-4
000227  PBAR    4000    7075    139.933 51600.  51600.  103200. .0114
000228  $*************************************************************************
000229  $
000230  $       COMPONENT NO. 5         PRESSURE VESSEL CLOSURE
000231  $
000232  CBAR    5000    5000    5000    4030
000233  CBAR    5010    5010    5010    5000
000234  GRID    5000            115.97
000235  GRID    5010            110.28
000236  PBAR    5000    7075    233.1   81850.  81850.  163700. .0545
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000237  PBAR    5010    7075    290.28  64000.  64000.  12800.  .0545
000238  $*************************************************************************
000239  $
000240  $       CONPONENT NO.6          LOWER THRUST STRUCTURE
000241  $
000242  CBAR    6000    6000    6000    5010
000243  CBAR    6010    6000    6010    6000
000244  CBAR    6020    6000    6020    6010
000245  CBAR    6030    6000    6030    6020
000246  CBAR    6040    6040    6040    6030
000247  CBAR    6050    6050    6050    6040
000248  CBAR    6060    6060    6060    6050
000249  CBAR    6070    6070    6070    6060
000250  GRID    6000            98.0
000251  GRID    6010            86.33
000252  GRID    6020            74.50
000253  GRID    6030            68.58
000254  GRID    6040            57.0
000255  GRID    6050            39.5
000256  GRID    6060            32.38
000257  GRID    6070            29.0
000258  GRID    6080    8000    25.0    125.0   39.50           23456
000259  GRID    6130    8000    25.0    215.0   39.50           23456
000260  MAT1    7039    10.1E6  3.78E6          2.56E-4
000261  PBAR    6000    7039    11.94   2155.   2155.   4310.   .0282
000262  PBAR    6040    7039    11.64   1989.   1989.   3978.   .0282
000263  PBAR    6050    7039    10.681  1543.   1543.   3087.   .0282
000264  PBAR    6060    7039    9.90    1228.   1228.   2456.   .0282
000265  PBAR    6070    7039    9.58    1114.   1114.   2228.   .0282
000266  $*************************************************************************
000267  $
000268  $       COMPONENT NO. 7         GIMBAL
000269  $
000270  CBAR    7031    7031    7030    7000    0.0     10.0    -10.0   1       7031
000271  +7031           4
000272  CBAR    7032    7031    7030    7040    0.0     10.0    10.0    1       7032
000273  +7032           4
000274  CBAR    7033    7031    7030    7010    0.0     -10.0   10.0    1       7033
000275  +7033           4
000276  CBAR    7034    7031    7030    7020    0.0     -10.0   -10.0   1       7034
000277  +7034           4
000278  CONROD  7021    7020    8001    250     2.0
000279  CONROD  7022    7020    8010    250     2.0
000280  CONROD  7023    7020    8002    250     2.0
000281  CONROD  7024    7020    8000    250     2.0
000282  CONROD  7041    7040    8030    250     2.0
000283  CONROD  7042    7040    8021    250     2.0
000284  CONROD  7043    7040    8022    250     2.0
000285  CONROD  7044    7040    8020    250     2.0
000286  CTRIA2  7121    8012    8000    8005    7020
000287  CTRIA2  7122    8012    8001    8005    7020
000288  CTRIA2  7123    8012    8002    8005    7020
000289  CTRIA2  7124    8012    8010    8005    7020
000290  CTRIA2  7125    8012    8001    8000    7020
000291  CTRIA2  7126    8012    8000    8002    7020
000292  CTRIA2  7127    8012    8002    8010    7020
000293  CTRIA2  7128    8012    8010    8001    7020
000294  CTRIA2  7141    8012    8020    8025    7040
000295  CTRIA2  7142    8012    8021    8025    7040
000296  CTRIA2  7143    8012    8022    8025    7040
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000297          CTRIA2  7144    8012    8030    8025    7040
000298          CTRIA2  7145    8012    8021    8020    7040
000299          CTRIA2  7146    8012    8020    8022    7040
000300          CTRIA2  7147    8012    8022    8030    7040
000301          CTRIA2  7148    8012    8030    8021    7040
000302          GRID    7000            23.0    0.0     -10.25
000303          GRID    7010            23.0    0.0     10.25
000304          GRID    7020            23.0    -10.25  0.0
000305          GRID    7030            23.0    0.0     0.0
000306          GRID    7040            23.0    10.25   0.0
000307          MAT1    250     24.0E6  9.24E6          7.33E-4
000308          PBAR    7031    250     3.0     10.0    10.0    20.0
000309          $*************************************************************************
000310          $
000311          $       COMPONENT NO. 8          UPPER THRUST STRUCTURE
000312          $
000313          CBAR    8000    8000    8090    8000    8160    0       0       2
000314          CBAR    8001    8000    8001    8040    8110    0       0       2
000315          CBAR    8002    8000    8190    8002    8110    0       0       2
000316          CBAR    8010    8000    8010    8050    8160    0       0       2
000317          CBAR    8021    8000    8021    8100    8140    0       0       2
000318          CBAR    8022    8000    8050    8022    8140    0       0       2
000319          CBAR    8030    8000    8030    8180    8140    0       0       2
000320          CBAR    8040    8000    8040    8020    8140    0       0       2
000321          CBAR    8050    8000    8050    8210    8160    0       0       2
000322          CBAR    8052    8000    8190    8050    8140    0       0       2
000323          CBAR    8061    8170    8060    8080    -10.0   -10.    0.0     1       8061
000324          +8061                   -3.4                    -3.4
000325          CBAR    8065    8190    8060    8080    -10.0   -10.0   0.0     1       8065
000326          +8065                   -2.5                    -2.5
000327          CBAR    8072    8000    8040    8070    8110    0       0       2
000328          CBAR    8073    8170    8070    8060    -10.0   -10.    0.0     1       8073
000329          +8073                   -3.4                    -3.4
000330          CBAR    8075    8190    8070    8060    -10.0   -10.0   0.0     1       8075
000331          +8075                   -2.5                    -2.5
000332          CBAR    8081    8000    8080    8040    8140    0       0       2
000333          CBAR    8085    8190    8080    8090    -10.0   -10.0   -10.0   1       8085
000334          +8085                   -2.5                    -2.5
000335          CBAR    8095    8190    8090    8120    -10.0   -3.75   -14.0   1       8095
000336          +8095                   -2.5                    -2.5
000337          CBAR    8105    8190    8100    8070    -10.0   -10.    10.     1       8105
000338          +8105                   -2.5                    -2.5
000339          CBAR    8125    8190    8120    8170    -10.0   3.75    -14.0   1       8125
000340          +8125                   -2.5                    -2.5
000341          CBAR    8155    8190    8150    8100    -10.0   -3.75   14.0    1       8155
000342          +8155                   -2.5                    -2.5
000343          CBAR    8171    8170    8170    8090    -10.0   0.0     10.0    1       8171
000344          +8171                   -3.4                    -3.4
000345          CBAR    8175    8190    8170    8190    -10.0   10.0    -10.0   1       8175
000346          +8175                   -2.5                    -2.5
000347          CBAR    8181    8170    8180    8100    -10.0   0.0     10.0    1       8181
000348          +8181                   -3.4                    -3.4
000349          CBAR    8165    8190    8180    8150    -10.0   3.75    14.0    1       8185
000350          +8185                   -2.5                    -2.5
000351          CBAR    8191    8170    8190    8200    -10.    10.     0.      1       8191
000352          +8191                   -3.4                    -3.4
000353          CBAR    8195    8190    8190    8200    -10.0   10.0    0.0     1       8195
000354          +8195                   -2.5                    -2.5
000355          CBAR    8201    8170    8200    8210    -10.    10.     0.      1       8201
000356          +8201                   -3.4                    -3.4
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000357    CBAR    8205    8190    8200    8210    -10.0   10.0    0.0     1       8205
000358    +8205                   -2.5                    -2.5
000359    CBAR    8215    8190    8210    8180    -10.0   10.     10.     1       8215
000360    +8215                   -2.5                    -2.5
000361    CQDMEM  8006    8006    8040    8110    8130    8001
000362    CQDMEM  8011    8006    8050    8160    8130    8010
000363    CQDMEM  8043    8006    8040    8110    8140    8020
000364    CQDMEM  8192    8006    8050    8160    8140    8022
000365    CROD    8041    8041    8040    8110    8051    8041    8050    8160
000366    CROD    8071    8130    8110    8070    8161    8130    8190    8160
000367    CROD    8111    8130    8110    8140    8140    8130    8140    8180
000368    CROD    8130    8130    8090    8130    8160    8130    8130    8160
000369    CROD    8162    8130    8160    8140    8163    8130    8140    8100
000370    CROD    8171    8130    8170    8130    8131    8130    8130    8110
000371    CROD    8210    8130    8160    8210    8110    8130    8080    8110
000372    CTRIA2  8001    8001    8000    8130    8090
000373    CTRIA2  8002    8002    8005    8130    8000
000374    CTRIA2  8003    8002    8005    8130    8010
000375    CTRIA2  8004    8001    8002    8130    8170
000376    CTRIA2  8005    8002    8005    8130    8002
000377    CTRIA2  8007    8001    8040    8110    8070
000378    CTRIA2  8008    8002    8005    8130    8001
000379    CTRIA2  8012    8012    8000    8001    8005
000380    CTRIA2  8013    8012    8001    8010    8005
000381    CTRIA2  8014    8012    8010    8002    8005
000382    CTRIA2  8015    8012    8002    8000    8005
000383    CTRIA2  8026    8002    8025    8140    8020
000384    CTRIA2  8027    8002    8025    8140    8030
000385    CTRIA2  8031    8001    8030    8140    8180
000386    CTRIA2  8032    8012    8021    8030    8025
000387    CTRIA2  8033    8012    8030    8022    8025
000388    CTRIA2  8034    8012    8022    8020    8025
000389    CTRIA2  8036    8012    8020    8021    8025
000390    CTRIA2  8052    8001    8050    8160    8210
000391    CTRIA2  8082    8001    8040    8110    8080
000392    CTRIA2  8121    8001    8090    8120    8170
000393    CTRIA2  8151    8001    8100    8150    8180
000394    CTRIA2  8191    8001    8050    8160    8190
000395    CTRIA2  8193    8002    8025    8140    8022
000396    CTRIA2  8194    8002    8025    8140    8021
000397    CTRIA2  8195    8001    8021    8140    8100
000398    GRID    8000            17.0    -13.25  3.0
000399    GRID    8001            17.0    -7.25   3.0
000400    GRID    8002            17.0    -13.25  -3.0
000401    GRID    8005            17.0    -10.25  0.0
000402    GRID    8010            17.0    -7.25   -3.0
000403    GRID    8020            17.0    7.25    3.0
000404    GRID    8021            17.0    13.25   3.0
000405    GRID    8022            17.0    7.25    -3.0
000406    GRID    8025            17.0    10.25   0.0
000407    GRID    8030            17.0    13.25   -3.0
000408    GRID    8040            17.0    0.0     10.25
000409    GRID    8050            17.0    0.0     -10.25
000410    GRID    8060            0.0     0.0     24.25
000411    GRID    8070    8000    28.0    60.     0.0
000412    GRID    8080    8000    28.0    120.    0.0
000413    GRID    8090    8000    28.0    150.    0.0
000414    GRID    8100    8000    28.0    30.     0.0
000415    GRID    8110            0.0     0.0     10.25
000416    GRID    8120    8000    28.0    180.    .0
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000417  GRID    8130            0.0     -10.25  .0
000418  GRID    8140            0.0     10.25   .0
000419  GRID    8150    8000    28.0    .0      .0
000420  GRID    8160            0.0     .0      -10.25
000421  GRID    8170    8000    28.0    -150.   .0
000422  GRID    8180    8000    28.0    -30.    .0
000423  GRID    8190    8000    28.0    -120.   .0
000424  GRID    8200            0.0     .0      -24.25
000425  GRID    8210    8000    28.0    -60.    .0
000426  GRID    8300    8000    25.0    215.0   0.0     0       23456
000427  GRID    8400    8000    25.0    125.0   0.0     0       23456
000428  MAT1    2024    10.5E6  4.0E6           2.6E-4
000429  PBAR    8000    2024    1.17    .08     .26
000430  PBAR    8170    2024    0.50    4.3     .0002
000431  PBAR    8190    2024    .8      2.36    2.36    3.55
000432  PQDMEM  8006    2024    0.10
000433  PROD    8041    2024    0.35
000434  PROD    8130    2024    0.435
000435  PTRIA2  8001    2024    0.064
000436  PTRIA2  8002    2024    0.20
000437  PTRIA2  8012    2024    .125
000438  $*************************************************************************
000439  $
000440  $                       M I N I - T A N K
000441  $
000442  $                           LOWER (AFT) TRUSS
000443  CROD    85001   8500    8500    8080    85002   8500    8500    8070
000444  CROD    85011   8500    8501    8090    85012   8500    8501    8060
000445  CROD    85021   8500    8502    8060    85022   8500    8502    8100
000446  CROD    85031   8500    8503    8120    85032   8500    8503    8080
000447  CROD    85041   8500    8504    8070    85042   8500    8504    8150
000448  CROD    85051   8500    8505    8170    85052   8500    8505    8090
000449  CROD    85061   8500    8506    8100    85062   8500    8506    8180
000450  CROD    85071   8500    8507    8190    85072   8500    8507    8120
000451  CROD    85081   8500    8508    8150    85082   8500    8508    8210
000452  CROD    85091   8500    8509    8200    85092   8500    8509    8170
000453  CROD    85101   8500    8510    8180    85102   8500    8510    8200
000454  CROD    85111   8500    8511    8210    85112   8500    8511    8190
000455  GRID    8500    8000    68.9330390.     -69.39698000    456
000456  GRID    8501    8000    68.93303120.    -69.39698000    456
000457  GRID    8502    8000    68.9330360.     -69.39698000    456
000458  GRID    8503    8000    68.93303150.    -69.39698000    456
000459  GRID    8504    8000    68.9330330.     -69.39698000    456
000460  GRID    8505    8000    68.93303180.    -69.39698000    456
000461  GRID    8506    8000    68.93303.0      -69.39698000    456
000462  GRID    8507    8000    68.93303-150.   -69.39698000    456
000463  GRID    8508    8000    68.93303-30.    -69.39698000    456
000464  GRID    8509    8000    68.93303-120.   -69.39698000    456
000465  GRID    8510    8000    68.93303-60.    -69.39698000    456
000466  GRID    8511    8000    68.93303-90.    -69.39698000    456
000467  PROD    8500    8500    0.767
000468  $                           UPPER (FORWARD) TRUSS
000469  CROD    86001   8600    8600    8701    86002   8600    8600    8702
000470  CROD    86011   8600    8601    8703    86012   8600    8601    8700
000471  CROD    86021   8600    8602    8700    86022   8600    8602    8704
000472  CROD    86031   8600    8603    8705    86032   8600    8603    8701
000473  CROD    86041   8600    8604    8702    86042   8600    8604    8706
000474  CROD    86051   8600    8605    8707    86052   8600    8605    8703
000475  CROD    86061   8600    8606    8704    86062   8600    8606    8708
000476  CROD    86071   8600    8607    8709    86072   8600    8607    8705
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000477          CROD    86081   8600    8608    8706    86082   8600    8608    8710
000478          CROD    86091   8600    8609    8711    86092   8600    8609    8707
000479          CROD    86101   8600    8610    8708    86102   8600    8610    8711
000480          CROD    86111   8600    8611    8710    86112   8600    8611    8709
000481          GRID    8600    8000    80.0    90.     -219.0  8000    456
000482          GRID    8601    8000    80.0    120.    -219.0  8000    456
000483          GRID    8602    8000    80.0    60.     -219.0  8000    456
000484          GRID    8603    8000    80.     150.    -219.0  8000    456
000485          GRID    8604    8000    80.     30.     -219.0  8000    456
000486          GRID    8605    8000    80.     180.    -219.0  8000    456
000487          GRID    8606    8000    80.     .0      -219.0  8000    456
000488          GRID    8607    8000    80.     -150.   -219.0  8000    456
000489          GRID    8608    8000    80.     -30.    -219.0  8000    456
000490          GRID    8609    8000    80.     -120.   -219.0  8000    456
000491          GRID    8610    8000    80.     -60.    -219.0  8000    456
000492          GRID    8611    8000    80.     -90.    -219.0  8000    456
000493          GRID    8700    8000    85.0    90.     -320.           456
000494          GRID    8701    8000    85.0    120.    -320.           456
000495          GRID    8702    8000    85.0    60.     -320.           456
000496          GRID    8703    8000    85.0    150.    -320.           456
000497          GRID    8704    8000    85.0    30.     -320.           456
000498          GRID    8705    8000    85.0    180.    -320.           456
000499          GRID    8706    8000    85.0    .0      -320.           456
000500          GRID    8707    8000    85.0    -150.   -320.           456
000501          GRID    8708    8000    85.0    -30.    -320.           456
000502          GRID    8709    8000    85.0    -120.   -320.           456
000503          GRID    8710    8000    85.0    -60.    -320.           456
000504          GRID    8711    8000    85.0    -90.    -320.           456
000505          PROD    8600    8500    0.868
000506          MAT1    8500    5.75E6          0.3     1.75E-4
000507          $       ALL CARGO BAY INTERFACE POINTS ARE TO REMAIN IN THE SAME PLANE
000508          MPC     8700    8701    1       1.0     8700    1       -1.0
000509          MPC     8700    8702    1       1.0     8700    1       -1.0
000510          MPC     8700    8703    1       1.0     8700    1       -1.0
000511          MPC     8700    8704    1       1.0     8700    1       -1.0
000512          MPC     8700    8705    1       1.0     8700    1       -1.0
000513          MPC     8700    8706    1       1.0     8700    1       -1.0
000514          MPC     8700    8707    1       1.0     8700    1       -1.0
000515          MPC     8700    8708    1       1.0     8700    1       -1.0
000516          MPC     8700    8709    1       1.0     8700    1       -1.0
000517          MPC     8700    8710    1       1.0     8700    1       -1.0
000518          MPC     8700    8711    1       1.0     8700    1       -1.0
000519          MPC     8700    8701    2       1.0     8700    2       -1.0
000520          MPC     8700    8702    2       1.0     8700    2       -1.0
000521          MPC     8700    8703    2       1.0     8700    2       -1.0
000522          MPC     8700    8704    2       1.0     8700    2       -1.0
000523          MPC     8700    8705    2       1.0     8700    2       -1.0
000524          MPC     8700    8706    2       1.0     8700    2       -1.0
000525          MPC     8700    8707    2       1.0     8700    2       -1.0
000526          MPC     8700    8708    2       1.0     8700    2       -1.0
000527          MPC     8700    8709    2       1.0     8700    2       -1.0
000528          MPC     8700    8710    2       1.0     8700    2       -1.0
000529          MPC     8700    8711    2       1.0     8700    2       -1.0
000530          MPC     8700    8701    3       1.0     8700    3       -1.0
000531          MPC     8700    8702    3       1.0     8700    3       -1.0
000532          MPC     8700    8703    3       1.0     8700    3       -1.0
000533          MPC     8700    8704    3       1.0     8700    3       -1.0
000534          MPC     8700    8705    3       1.0     8700    3       -1.0
000535          MPC     8700    8706    3       1.0     8700    3       -1.0
000536          MPC     8700    8707    3       1.0     8700    3       -1.0
```

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000537  MPC     8700    8708    3       1.0     8700    3       -1.0
000538  MPC     8700    8709    3       1.0     8700    3       -1.0
000539  MPC     8700    8710    3       1.0     8700    3       -1.0
000540  MPC     8700    8711    3       1.0     8700    3       -1.0
000541  $               MODAL COORDINATE DATA
000542  SPOINT  101     THRU    109
000543  CMASS4  101     2.927   101
000544  CMASS4  102     2.927   102
000545  CMASS4  103     0.664   103
000546  CMASS4  104     1.311   104
000547  CMASS4  105     0.444   105
000548  CMASS4  106     0.2018  106
000549  CMASS4  107     0.1584  107
000550  CMASS4  108     0.1940  108
000551  CMASS4  109     0.2043  109
000552  CELAS4  204     1.251E6 104
000553  CELAS4  205     1.262E6 105
000554  CELAS4  206     7.457E5 106
000555  CELAS4  207     6.729E5 107
000556  CELAS4  208     8.818E5 108
000557  CELAS4  209     9.914E5 109
000558  $           THESE ARE THE MPC'S FOR THE MODAL CONSTRAINTS
000559  $             MODAL CONSTRAINT EQUATIONS
000560  $*************************************************************************
000561  $
000562  $                       GIMBAL  ACTUATORS
000563  $
000564  CELAS2  8301    1.15E6  6130    1       8300    1
000565  CELAS2  8401    1.15E6  6080    1       8400    1
000566  $*************************************************************************
000567  $
000568  $               T P A   STRUCTURE USED FOR ALL MINI-TANK RUNS
000569  $
000570  $               T P A   # 1
000571  GRID    6061    8000    35.0    -90.    43.             456
000572  CONM2   9007    6061            1.97
000573  CELAS2  60611   2.0E+6  6061    1       6070    1
000574  CELAS2  606121  2.0E+6  6061    2       6070    2
000575  CELAS2  606122  1.4E+6  6061    2       6040    2
000576  CELAS2  606131  2.0E+6  6061    3       6070    3
000577  CELAS2  606132  1.4E+6  6061    3       6040    3
000578  $
000579  $               T P A   # 2
000580  GRID    6062    8000    35.0     90.    43.             456
000581  CONM2   9008    6062            1.97
000582  CELAS2  60621   2.0E+6  6062    1       6070    1
000583  CELAS2  606221  2.0E+6  6062    2       6070    2
000584  CELAS2  606222  1.4E+6  6062    2       6040    2
000585  CELAS2  606231  2.0E+6  6062    3       6070    3
000586  CELAS2  606232  1.4E+6  6062    3       6040    3
000587  $*************************************************************************
000588  $
000589  $                       EOS SUPPORT FRAME
000590  $
000591  CELAS2  3055    3.5E6   3050    1       3051
000592  CELAS2  3056    3.5E6   3050    2       3052
000593  CELAS2  3057    3.5E6   3050    3       3053
000594  CELAS2  3058    4.0E7   3050    4
000595  CELAS2  6001    3.5E6   6000    1       6001
000596  CELAS2  6002    3.5E6   6000    2       6002
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000597          CELAS2  6003    3.5E6   6000    3       6003
000598          CELAS2  6004    4.0E7   6000    4
000599          CELAS2  8701    1.E6    8700    1
000600          CELAS2  8702    1.E6    8700    2
000601          CELAS2  8703    1.E6    8700    3
000602          CONM2   8700    8700            1.E6
000603          MPC     8700    3051    0       1.0     8700    1       -1.0
000604          MPC     8700    3052    0       1.0     8700    2       -1.0
000605          MPC     8700    3053    0       1.0     8700    3       -1.0
000606          MPC     8700    6001    0       1.0     8700    1       -1.0
000607          MPC     8700    6002    0       1.0     8700    2       -1.0
000608          MPC     8700    6003    0       1.0     8700    3       -1.0
000609          SPOINT  3051    3052    3053    6001    6002    6003
000610          $*******************************************************************************
```

APPENDIX A

CASE 6

14

@ ELT EOS/CASE6,1,720114, 42460

```
000001  BAROR                                   1000.0  1000.0  0.0     1
000002  $*************************************************************************
000003  $
000004  $                       COORDINATE SYSTEM DEFINITIONS
000005  $
000006  CORD2C  2               256.1   .0      .0      300.    .0      .0      BC
000007  +BC     300.0   -50.0   0.0
000008  CORD2C  8000            0.0     0.0     0.0     1000.0  0.0     0.0     CYL
000009  +CYL    1000.0  1000.0  0.0
000010  $*************************************************************************
000011  $
000012  $       SUPORT CARD FOR RIGID BODY MODES
000013  $
000014  $*************************************************************************-1
000015  $
000016  $                       EIGENVALUE EXTRACTION
000017  $
000018  EIGR    25      GIV                             25              1.E-6   GIV25
000019  +GIV25  MAX
000020  $*************************************************************************
000021  $
000022  $                       SINGLE-POINT CONSTRAINT SETS
000023  $
000024  SPC1    10      123456  8700
000025  $*************************************************************************
000026  $
000027  $                               MULTI-POINT CONSTRAINTS
000028  $
000029  MPCADD  10      6062    7000    7010    8300    8500    8700
000030  $
000031  $           MPC TPA #2 TO TPA #1
000032  MPC     6062    6062    1       1.0     6061    1       -1.0
000033  MPC     6062    6062    2       1.0     6061    2       -1.0
000034  MPC     6062    6062    3       1.0     6061    3       -1.0
000035  MPC     7000    7000    1       1.0     6070    1       -1.0            7000X
000036  +7000X          6070    5       10.25
000037  MPC     7000    7000    2       1.0     6070    2       -1.0            7000Y
000038  +7000Y          6070    4       -10.25  6070    6       6.0
000039  MPC     7000    7000    3       1.0     6070    3       -1.0            7000Z
000040  +7000Z          6070    5       -6.0
000041  MPC     7000    7000    4       1.0     6070    4       -1.0
000042  MPC     7000    7000    5       1.0     6070    5       -1.0
000043  MPC     7000    7000    6       1.0     6070    6       -1.0
000044  MPC     7010    7010    1       1.0     6070    1       -1.0            7010X
000045  +7010X          6070    5       -10.25
000046  MPC     7010    7010    2       1.0     6070    2       -1.0            7010Y
000047  +7010Y          6070    4       10.25   6070    6       6.0
000048  MPC     7010    7010    3       1.0     6070    3       -1.0            7010Z
000049  +7010Z          6070    5       -6.0
000050  MPC     7010    7010    4       1.0     6070    4       -1.0
000051  MPC     7010    7010    5       1.0     6070    5       -1.0
000052  MPC     7010    7010    6       1.0     6070    6       -1.0
000053  MPC     8300    6080    1       1.0     6050    1       -1.0            6080A
000054  +6080A          6050    5       -20.48  6050    6       -14.34
000055  MPC     8300    6130    1       1.0     6050    1       -1.0            6130A
000056  +6130A          6050    5       14.34   6050    6       -20.48
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000057          MPC     8300    8300    1       1.0     8170    1       -1.0
000058          MPC     8300    8400    1       1.0     8080    1       -1.0
000059          $*************************************************************************
000060          $
000061          $                       OMITTED COORDINATE SET
000062          $
000063          OMIT1   123456  2020    3010    3030    3040    4025    8000    8001    6DOFA
000064          +6DOFA  8002    8005    8010    8020    8021    8022    8160    8030    6DOFB
000065          +6DOFB  8110    8130    8140    4010
000066          OMIT1   456     2000    8170    2040    3000    8210    3020    8180    3DOFA
000067          +3DOFA  8190    4000    8150    4020    8200    4030    5000    6000    3DOFB
000068          +3DOFB  6020    6030    6040    6070    7020    7030    7040    8040    3DOFC
000069          +3DOFC  8050    8060    8070    8080    8090    8100    8120
000070          $*************************************************************************
000071          $
000072          $                           PARAM CARDS
000073          $
000074          PARAM   GRDPNT  0
000075          $*************************************************************************
000076          $
000077          $               GLOBAL AXES FOR PLOT ORIENTATION
000078          $
000079          GRID    1               430.                            123456
000080          GRID    2                       50.                     123456
000081          GRID    3                               50.             123456
000082          GRID    10              420.                            123456
000083          GRID    20                      40.                     123456
000084          GRID    30                              40.             123456
000085          PLOTEL  9001    10      1
000086          PLOTEL  9002    20      2
000087          PLOTEL  9003    30      3
000088          PLOTEL  9010    8120    8005            9011    8005    8025
000089          PLOTEL  9012    8025    8150            9013    8150    8140
000090          PLOTEL  9014    8140    8130            9015    8130    8120
000091          PLOTEL  9020    8200    8050            9021    8050    8040
000092          PLOTEL  9022    8040    8060            9023    8060    8110
000093          PLOTEL  9024    8110    8160            9025    8160    8200
000094          $*************************************************************************
000095          $
000096          $       C O N C E N T R A T E D   M A S S   I T E M S
000097          $
000098          $                       P   F   S
000099          CONM2   9001    2050    2       0.15    28.82   17.6    -2.09
000100          CONM2   9002    5010            .037    -3.36   12.4    7.12
000101          CONM2   9003    5010            1.19    -2.82   .0      .0
000102          CONM2   9004    6060            0.98    2.42    -26.1   .0
000103          CONM2   9005    6050            .86     -1.5    26.5    14.5
000104          CONM2   9006    6050            0.92    4.50    27.5    0.0
000105          $               DESTRUCT SUBSYSTEM
000106          $
000107          $               NOZZLE TO EXTENSION ATTACHMENT
000108          CONM2   2051    2050            .0855                           NEA
000109          +NEA    72.             36.                     36.
000110          $               CORE SUPPORT
000111          CONM2   3051    3050            0.668   -4.93                   CS
000112          +CS     328.            170.                    170.
000113          $               FLANGE
000114          CONM2   3052    3050            1.08    2.07                    FLANGE
000115          +FLANGE 594.            298.                    298.
000116          $               AFT RING
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000117          CONM2   2052    2050            0.40                                    RING
000118          +RING   335.            168.                    168.
000119          $               TORUS
000120          CONM2   2053    2050            0.198   -3.11                           TORUS
000121          +TORUS  181.            91.                     91.
000122          $               NOZZLE TO PV BOLTS
000123          CONM2   3057    3050            .096    1.07                            BOLTS
000124          +BOLTS  51.15           25.65                   25.65
000125          $               CONTROL DRUM ACTUATORS (18)
000126          CONM2   5011    5010    8000    .0344   24.5    10.
000127          CONM2   5012    5010    8000    .0344   24.5    30.
000128          CONM2   5013    5010    8000    .0344   24.5    50.
000129          CONM2   5014    5010    8000    .0344   24.5    70.
000130          CONM2   5015    5010    8000    .0344   24.50   90.
000131          CONM2   5016    5010    8000    .0344   24.50   110.
000132          CONM2   5017    5010    8000    .0344   24.50   130.
000133          CONM2   5018    5010    8000    .0344   24.50   150.
000134          CONM2   5019    5010    8000    .0344   24.50   170.
000135          CONM2   50110   5010    8000    .0344   24.50   190.
000136          CONM2   50111   5010    8000    .0344   24.50   210.
000137          CONM2   50112   5010    8000    .0344   24.50   230.
000138          CONM2   50113   5010    8000    .0344   24.50   250.
000139          CONM2   50114   5010    8000    .0344   24.50   270.
000140          CONM2   50115   5010    8000    .0344   24.50   290.
000141          CONM2   50116   5010    8000    .0344   24.50   310.
000142          CONM2   50117   5010    8000    .0344   24.50   330.
000143          CONM2   50118   5010    8000    .0344   24.50   350.
000144          $               SHIELD
000145          $                       S H I E L D   R E M O V E D
000146          OMIT1   456     6010
000147          $               NDICE
000148          CONM2   6021    6020            1.55
000149          $                       ACTUATORS
000150          CONM2   60801   6080            0.24
000151          CONM2   61301   6130            0.24
000152          CONM2   83001   8300            0.24
000153          CONM2   84001   8400            0.24
000154          $                       SIMPLE NSS
000155          CONM2   4001    4001            29.
000156          CONM2   4002    4002            6.02
000157          CONM2   4003    4003            2.90
000158          $*************************************************************************
000159          $
000160          $       COMPONENT NO. 2          NOZZLE EXTENSION
000161          $
000162          CBAR    2020    2020    2020    2000
000163          CBAR    2040    2040    2040    2020
000164          CBAR    2050    2050    2050    2040
000165          GRID    2000            409.372
000166          GRID    2020            351.543
000167          GRID    2040            296.865
000168          GRID    2050            270.190
000169          MAT1    100     1.7E6   0.7056          1.355E-4
000170          PBAR    2020    100     40.865  55550.  55550.  111100. .00445
000171          PBAR    2040    100     33.253  30250.  30250.  60500.  .00445
000172          PBAR    2050    100     50.047  25400.  25400.  50800.  .00445
000173          $*************************************************************************
000174          $
000175          $       COMPONENT NO. 3          NOZZLE
000176          $
```

```
000177          CBAR    3000    3000    3000    2050
000178          CBAR    3010    3010    3010    3000
000179          CBAR    3020    3020    3020    3010
000180          CBAR    3030    3030    3030    3020
000181          CBAR    3040    3040    3040    3030
000182          CBAR    3050    3050    3050    3040
000183          GRID    3000            254.218
000184          GRID    3010            233.25
000185          GRID    3020            225.90
000186          GRID    3030            220.491
000187          GRID    3040            213.236
000188          GRID    3050            206.93
000189          MAT1    347     29.3E6  11.4E6          7.394E-4
000190          PBAR    3000    347     11.5    3414.   3414.   6828.   .007
000191          PBAR    3010    347     32.3    4371.   4371.   8742.   .007
000192          PBAR    3020    347     16.3    567.    567.    1133.   .007
000193          PBAR    3030    347     13.7    333.    333.    666.    .007
000194          PBAR    3040    347     25.2    2070.   2070.   4140.   .007
000195          PBAR    3050    347     82.2    16170.  16170.  32340.  .007
000196          $*************************************************************************
000197          $
000198          $       NUCLEAR SUBSYSTEM           SIMPLE MODEL
000199          $
000200          CELAS2  40011   41.8E6  4001    1       3050    1
000201          CELAS2  40012   9.41E6  4001    2       3050    2
000202          CELAS2  40013   9.41E6  4001    3       3050    3
000203          CELAS2  40021   334.E6  4002    1       4001    1
000204          CELAS2  40022   61.7E6  4002    2       4001    2
000205          CELAS2  40023   61.7E6  4002    3       4001    3
000206          CELAS2  40031   0.48E6  4003    1       4002    1
000207          CELAS2  40032   16.5E6  4003    2       4002    2
000208          CELAS2  40033   16.5E6  4003    3       4002    3
000209          GRID    4001            170.0                           456
000210          GRID    4002            129.0                           456
000211          GRID    4003            124.0                           456
000212          $*************************************************************************
000213          $
000214          $       COMPONENT NO. 4           PRESSURE VESSEL
000215          $
000216          CBAR    4000    4000    4000    3050
000217          CBAR    4010    4000    4010    4000
000218          CBAR    4020    4000    4020    4010
000219          CBAR    4025    4000    4025    4020
000220          CBAR    4030    4000    4030    4025
000221          GRID    4000            185.5175
000222          GRID    4010            164.105
000223          GRID    4020            142.6925
000224          GRID    4025            124.67
000225          GRID    4030            121.28
000226          MAT1    7075    10.3E6  3.9E6           2.616E-4
000227          PBAR    4000    7075    139.933 51600.  51600.  103200. .0114
000228          $*************************************************************************
000229          $
000230          $       COMPONENT NO. 5           PRESSURE VESSEL CLOSURE
000231          $
000232          CBAR    5000    5000    5000    4030
000233          CBAR    5010    5010    5010    5000
000234          GRID    5000            115.97
000235          GRID    5010            110.28
000236          PBAR    5000    7075    233.1   81850.  81850.  163700. .0545
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000237  PBAR    5010    7075    290.28  64000.  64000.  12800.  .0545
000238  $*************************************************************************
000239  $
000240  $       CONPONENT NO.6          LOWER THRUST STRUCTURE
000241  $
000242  CBAR    6000    6000    6000    5010
000243  CBAR    6010    6000    6010    6000
000244  CBAR    6020    6000    6020    6010
000245  CBAR    6030    6000    6030    6020
000246  CBAR    6040    6040    6040    6030
000247  CBAR    6050    6050    6050    6040
000248  CBAR    6060    6060    6060    6050
000249  CBAR    6070    6070    6070    6060
000250  GRID    6000            98.0
000251  GRID    6010            86.33
000252  GRID    6020            74.50
000253  GRID    6030            68.58
000254  GRID    6040            57.0
000255  GRID    6050            39.5
000256  GRID    6060            32.38
000257  GRID    6070            29.0
000258  GRID    6080    8000    25.0    125.0   39.50           23456
000259  GRID    6130    8000    25.0    215.0   39.50           23456
000260  MAT1    7039    10.1E6  3.78E6          2.56E-4
000261  PBAR    6000    7039    11.94   2155.   2155.   4310.   .0282
000262  PBAR    6040    7039    11.64   1989.   1989.   3978.   .0282
000263  PBAR    6050    7039    10.681  1543.   1543.   3087.   .0282
000264  PBAR    6060    7039    9.90    1228.   1228.   2456.   .0282
000265  PBAR    6070    7039    9.58    1114.   1114.   2228.   .0282
000266  $*************************************************************************
000267  $
000268  $       COMPONENT NO. 7         GIMBAL
000269  $
000270  CBAR    7031    7031    7030    7000    0.0     10.0    -10.0   1       7031
000271  +7031           4
000272  CBAR    7032    7031    7030    7040    0.0     10.0    10.0    1       7032
000273  +7032           4
000274  CBAR    7033    7031    7030    7010    0.0     -10.0   10.0    1       7033
000275  +7033           4
000276  CBAR    7034    7031    7030    7020    0.0     -10.0   -10.0   1       7034
000277  +7034           4
000278  CONROD  7021    7020    8001    250     2.0
000279  CONROD  7022    7020    8010    250     2.0
000280  CONROD  7023    7020    8002    250     2.0
000281  CONROD  7024    7020    8000    250     2.0
000282  CONROD  7041    7040    8030    250     2.0
000283  CONROD  7042    7040    8021    250     2.0
000284  CONROD  7043    7040    8022    250     2.0
000285  CONROD  7044    7040    8020    250     2.0
000286  CTRIA2  7121    8012    8000    8005    7020
000287  CTRIA2  7122    8012    8001    8005    7020
000288  CTRIA2  7123    8012    8002    8005    7020
000289  CTRIA2  7124    8012    8010    8005    7020
000290  CTRIA2  7125    8012    8001    8000    7020
000291  CTRIA2  7126    8012    8000    8002    7020
000292  CTRIA2  7127    8012    8002    8010    7020
000293  CTRIA2  7128    8012    8010    8001    7020
000294  CTRIA2  7141    8012    8020    8025    7040
000295  CTRIA2  7142    8012    8021    8025    7040
000296  CTRIA2  7143    8012    8022    8025    7040
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000297          CTRIA2  7144    8012    8030    8025    7040
000298          CTRIA2  7145    8012    8021    8020    7040
000299          CTRIA2  7146    8012    8020    8022    7040
000300          CTRIA2  7147    8012    8022    8030    7040
000301          CTRIA2  7148    8012    8030    8021    7040
000302          GRID    7000            23.0    0.0     -10.25
000303          GRID    7010            23.0    0.0     10.25
000304          GRID    7020            23.0    -10.25  0.0
000305          GRID    7030            23.0    0.0     0.0
000306          GRID    7040            23.0    10.25   0.0
000307          MAT1    250     24.0E6  9.24E6          7.33E-4
000308          PBAR    7031    250     3.0     10.0    10.0    20.0
000309          $*************************************************************************
000310          $
000311          $       COMPONENT NO. 8.     UPPER THRUST STRUCTURE
000312          $
000313          CBAR    8000    8000    8090    8000    8160    0       0       2
000314          CBAR    8001    8000    8001    8040    8110    0       0       2
000315          CBAR    8002    8000    8170    8002    8110    0       0       2
000316          CBAR    8010    8000    8010    8050    8160    0       0       2
000317          CBAR    8021    8000    8021    8100    8140    0       0       2
000318          CBAR    8022    8000    8050    8022    8140    0       0       2
000319          CBAR    8030    8000    8030    8180    8140    0       0       2
000320          CBAR    8040    8000    8040    8020    8140    0       0       2
000321          CBAR    8050    8000    8050    8210    8160    0       0       2
000322          CBAR    8052    8000    8190    8050    8140    0       0       2
000323          CBAR    8061    8170    8060    8080    -10.0   -10.    0.0     1       8061
000324          +8061                   -3.4                    -3.4
000325          CBAR    8065    8190    8060    8080    -10.0   -10.0   0.0     1       8065
000326          +8065                   -2.5                    -2.5
000327          CBAR    8072    8000    8040    8070    8110    0       0       2
000328          CBAR    8073    8170    8070    8060    -10.0   -10.    0.0     1       8073
000329          +8073                   -3.4                    -3.4
000330          CBAR    8075    8190    8070    8060    -10.0   -10.0   0.0     1       8075
000331          +8075                   -2.5                    -2.5
000332          CBAR    8081    8000    8080    8040    8140    0       0       2
000333          CBAR    8085    8190    8080    8090    -10.0   -10.0   -10.0   1       8085
000334          +8085                   -2.5                    -2.5
000335          CBAR    8095    8190    8090    8120    -10.0   -3.75   -14.0   1       8095
000336          +8095                   -2.5                    -2.5
000337          CBAR    8105    8190    8100    8070    -10.0   -10.    10.     1       8105
000338          +8105                   -2.5                    -2.5
000339          CBAR    8125    8190    8120    8170    -10.0   3.75    -14.0   1       8125
000340          +8125                   -2.5                    -2.5
000341          CBAR    8155    8190    8150    8100    -10.0   -3.75   14.0    1       8155
000342          +8155                   -2.5                    -2.5
000343          CBAR    8171    8170    8170    8090    -10.0   0.0     10.0    1       8171
000344          +8171                   -3.4                    -3.4
000345          CBAR    8175    8190    8170    8190    -10.0   10.0    -10.0   1       8175
000346          +8175                   -2.5                    -2.5
000347          CBAR    8181    8170    8180    8100    -10.0   0.0     10.0    1       8181
000348          +8181                   -3.4                    -3.4
000349          CBAR    8185    8190    8180    8150    -10.0   3.75    14.0    1       8185
000350          +8185                   -2.5                    -2.5
000351          CBAR    8191    8170    8190    8200    -10.    10.     0.      1       8191
000352          +8191                   -3.4                    -3.4
000353          CBAR    8195    8190    8190    8200    -10.0   10.0    0.0     1       8195
000354          +8195                   -2.5                    -2.5
000355          CBAR    8201    8170    8200    8210    -10.    10.     0.      1       8201
000356          +8201                   -3.4                    -3.4
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000357  CBAR    8205    8190    8200    8210    -10.0   10.0    0.0     1       8205
000358  +8205                   -2.5                    -2.5
000359  CBAR    8215    8190    8210    8180    -10.0   10.     10.     1       8215
000360  +8215                   -2.5                    -2.5
000361  CQDMEM  8006    8006    8040    8110    8130    8001
000362  CQDMEM  8011    8006    8050    8160    8130    8010
000363  CQDMEM  8043    8006    8040    8110    8140    8020
000364  CQDMEM  8192    8006    8050    8160    8140    8022
000365  CROD    8041    8041    8040    8110    8051    8041    8050    8160
000366  CROD    8071    8130    8110    8070    8161    8130    8190    8160
000367  CROD    8111    8130    8110    8140    8140    8130    8140    8180
000368  CROD    8130    8130    8090    8130    8160    8130    8130    8160
000369  CROD    8162    8130    8160    8140    8163    8130    8140    8100
000370  CROD    8171    8130    8170    8130    8131    8130    8130    8110
000371  CROD    8210    8130    8160    8210    8110    8130    8080    8110
000372  CTRIA2  8001    8001    8000    8130    8090
000373  CTRIA2  8002    8002    8005    8130    8000
000374  CTRIA2  8003    8002    8005    8130    8010
000375  CTRIA2  8004    8001    8002    8130    8170
000376  CTRIA2  8005    8002    8005    8130    8002
000377  CTRIA2  8007    8001    8040    8110    8070
000378  CTRIA2  8008    8002    8005    8130    8001
000379  CTRIA2  8012    8012    8000    8001    8005
000380  CTRIA2  8013    8012    8001    8010    8005
000381  CTRIA2  8014    8012    8010    8002    8005
000382  CTRIA2  8015    8012    8002    8000    8005
000383  CTRIA2  8026    8002    8025    8140    8020
000384  CTRIA2  8027    8002    8025    8140    8030
000385  CTRIA2  8031    8001    8030    8140    8180
000386  CTRIA2  8032    8012    8021    8030    8025
000387  CTRIA2  8033    8012    8030    8022    8025
000388  CTRIA2  8034    8012    8022    8020    8025
000389  CTRIA2  8036    8012    8020    8021    8025
000390  CTRIA2  8052    8001    8050    8160    8210
000391  CTRIA2  8082    8001    8040    8110    8080
000392  CTRIA2  8121    8001    8090    8120    8170
000393  CTRIA2  8151    8001    8100    8150    8180
000394  CTRIA2  8191    8001    8050    8160    8190
000395  CTRIA2  8193    8002    8025    8140    8022
000396  CTRIA2  8194    8002    8025    8140    8021
000397  CTRIA2  8195    8001    8021    8140    8100
000398  GRID    8000            17.0    -13.25  3.0
000399  GRID    8001            17.0    -7.25   3.0
000400  GRID    8002            17.0    -13.25  -3.0
000401  GRID    8005            17.0    -10.25  0.0
000402  GRID    8010            17.0    -7.25   -3.0
000403  GRID    8020            17.0    7.25    3.0
000404  GRID    8021            17.0    13.25   3.0
000405  GRID    8022            17.0    7.25    -3.0
000406  GRID    8025            17.0    10.25   0.0
000407  GRID    8030            17.0    13.25   -3.0
000408  GRID    8040            17.0    0.0     10.25
000409  GRID    8050            17.0    0.0     -10.25
000410  GRID    8060            0.0     0.0     24.25
000411  GRID    8070    8000    28.0    60.     0.0
000412  GRID    8080    8000    28.0    120.    0.0
000413  GRID    8090    8000    28.0    150.    0.0
000414  GRID    8100    8000    28.0    30.     0.0
000415  GRID    8110            0.0     0.0     10.25
000416  GRID    8120    8000    28.0    180.    .0
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000417  GRID    8130            0.0     -10.25  .0
000418  GRID    8140            0.0     10.25   .0
000419  GRID    8150    8000    28.0    .0      .0
000420  GRID    8160            0.0     .0      -10.25
000421  GRID    8170    8000    28.0    -150.   .0
000422  GRID    8180    8000    28.0    -30.    .0
000423  GRID    8190    8000    28.0    -120.   .0
000424  GRID    8200            0.0     .0      -24.25
000425  GRID    8210    8000    28.0    -60.    .0
000426  GRID    8300    8000    25.0    215.0   0.0     0       23456
000427  GRID    8400    8000    25.0    125.0   0.0     0       23456
000428  MAT1    2024    10.5E6  4.0E6           2.6E-4
000429  PBAR    8000    2024    1.17    .08     .26
000430  PBAR    8170    2024    0.50    4.3     .0002
000431  PBAR    8190    2024    .8      2.36    2.36    3.55
000432  PQDMEM  8006    2024    0.10
000433  PROD    8041    2024    0.35
000434  PROD    8130    2024    0.435
000435  PTRIA2  8001    2024    0.064
000436  PTRIA2  8002    2024    0.20
000437  PTRIA2  8012    2024    .125
000438  $*************************************************************************
000439  $
000440  $                       M I N I - T A N K
000441  $
000442  $                       LOWER (AFT) TRUSS
000443  CROD    85001   8500    8500    8080    85002   8500    8500    8070
000444  CROD    85011   8500    8501    8090    85012   8500    8501    8060
000445  CROD    85021   8500    8502    8060    85022   8500    8502    8100
000446  CROD    85031   8500    8503    8120    85032   8500    8503    8080
000447  CROD    85041   8500    8504    8070    85042   8500    8504    8150
000448  CROD    85051   8500    8505    8170    85052   8500    8505    8090
000449  CROD    85061   8500    8506    8100    85062   8500    8506    8180
000450  CROD    85071   8500    8507    8190    85072   8500    8507    8120
000451  CROD    85081   8500    8508    8150    85082   8500    8508    8210
000452  CROD    85091   8500    8509    8200    85092   8500    8509    8170
000453  CROD    85101   8500    8510    8180    85102   8500    8510    8200
000454  CROD    85111   8500    8511    8210    85112   8500    8511    8190
000455  GRID    8500    8000    68.9330390.     -69.39698000    456
000456  GRID    8501    8000    68.93303120.    -69.39698000    456
000457  GRID    8502    8000    68.9330360.     -69.39698000    456
000458  GRID    8503    8000    68.93303150.    -69.39698000    456
000459  GRID    8504    8000    68.9330330.     -69.39698000    456
000460  GRID    8505    8000    68.93303180.    -69.39698000    456
000461  GRID    8506    8000    68.93303-30     -69.39698000    456
000462  GRID    8507    8000    68.93303-150.   -69.39698000    456
000463  GRID    8508    8000    68.93303-30.    -69.39698000    456
000464  GRID    8509    8000    68.93303-120.   -69.39698000    456
000465  GRID    8510    8000    68.93303-60.    -69.39698000    456
000466  GRID    8511    8000    68.93303-90.    -69.39698000    456
000467  PROD    8500    8500    0.767
000468  $                       UPPER (FORWARD) TRUSS
000469  CROD    86001   8600    8600    8701    86002   8600    8600    8702
000470  CROD    86011   8600    8601    8703    86012   8600    8601    8700
000471  CROD    86021   8600    8602    8700    86022   8600    8602    8704
000472  CROD    86031   8600    8603    8705    86032   8600    8603    8701
000473  CROD    86041   8600    8604    8702    86042   8600    8604    8706
000474  CROD    86051   8600    8605    8707    86052   8600    8605    8703
000475  CROD    86061   8600    8606    8704    86062   8600    8606    8708
000476  CROD    86071   8600    8607    8709    86072   8600    8607    8705
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000477          CROD    86081   8600    8608    8706    86082   8600    8608    8710
000478          CROD    86091   8600    8609    8711    86092   8600    8609    8707
000479          CROD    86101   8600    8610    8708    86102   8600    8610    8711
000480          CROD    86111   8600    8611    8710    86112   8600    8611    8709
000481          GRID    8600    8000    80.0    90.     -219.0  8000    456
000482          GRID    8601    8000    80.0    120.    -219.0  8000    456
000483          GRID    8602    8000    80.0    60.     -219.0  8000    456
000484          GRID    8603    8000    80.     150.    -219.0  8000    456
000485          GRID    8604    8000    80.     30.     -219.0  8000    456
000486          GRID    8605    8000    80.     180.    -219.0  8000    456
000487          GRID    8606    8000    80.     .0      -219.0  8000    456
000488          GRID    8607    8000    80.     -150.   -219.0  8000    456
000489          GRID    8608    8000    80.     -30.    -219.0  8000    456
000490          GRID    8609    8000    80.     -120.   -219.0  8000    456
000491          GRID    8610    8000    80.     -60.    -219.0  8000    456
000492          GRID    8611    8000    80.     -90.    -219.0  8000    456
000493          GRID    8700    8000    85.0    90.     -320.           456
000494          GRID    8701    8000    85.0    120.    -320.           456
000495          GRID    8702    8000    85.0    60.     -320.           456
000496          GRID    8703    8000    85.0    150.    -320.           456
000497          GRID    8704    8000    85.0    30.     -320.           456
000498          GRID    8705    8000    85.0    180.    -320.           456
000499          GRID    8706    8000    85.0    .0      -320.           456
000500          GRID    8707    8000    85.0    -150.   -320.           456
000501          GRID    8708    8000    85.0    -30.    -320.           456
000502          GRID    8709    8000    85.0    -120.   -320.           456
000503          GRID    8710    8000    85.0    -60.    -320.           456
000504          GRID    8711    8000    85.0    -90.    -320.           456
000505          PROD    8600    8500    0.868
000506          MAT1    8500    5.75E6          0.3     1.75E-4
000507          $       ALL CARGO BAY INTERFACE POINTS ARE TO REMAIN IN THE SAME PLANE
000508          MPC     8700    8701    1       1.0     8700    1       -1.0
000509          MPC     8700    8702    1       1.0     8700    1       -1.0
000510          MPC     8700    8703    1       1.0     8700    1       -1.0
000511          MPC     8700    8704    1       1.0     8700    1       -1.0
000512          MPC     8700    8705    1       1.0     8700    1       -1.0
000513          MPC     8700    8706    1       1.0     8700    1       -1.0
000514          MPC     8700    8707    1       1.0     8700    1       -1.0
000515          MPC     8700    8708    1       1.0     8700    1       -1.0
000516          MPC     8700    8709    1       1.0     8700    1       -1.0
000517          MPC     8700    8710    1       1.0     8700    1       -1.0
000518          MPC     8700    8711    1       1.0     8700    1       -1.0
000519          MPC     8700    8701    2       1.0     8700    2       -1.0
000520          MPC     8700    8702    2       1.0     8700    2       -1.0
000521          MPC     8700    8703    2       1.0     8700    2       -1.0
000522          MPC     8700    8704    2       1.0     8700    2       -1.0
000523          MPC     8700    8705    2       1.0     8700    2       -1.0
000524          MPC     8700    8706    2       1.0     8700    2       -1.0
000525          MPC     8700    8707    2       1.0     8700    2       -1.0
000526          MPC     8700    8708    2       1.0     8700    2       -1.0
000527          MPC     8700    8709    2       1.0     8700    2       -1.0
000528          MPC     8700    8710    2       1.0     8700    2       -1.0
000529          MPC     8700    8711    2       1.0     8700    2       -1.0
000530          MPC     8700    8701    3       1.0     8700    3       -1.0
000531          MPC     8700    8702    3       1.0     8700    3       -1.0
000532          MPC     8700    8703    3       1.0     8700    3       -1.0
000533          MPC     8700    8704    3       1.0     8700    3       -1.0
000534          MPC     8700    8705    3       1.0     8700    3       -1.0
000535          MPC     8700    8706    3       1.0     8700    3       -1.0
000536          MPC     8700    8707    3       1.0     8700    3       -1.0
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000537  MPC     8700    8708    3       1.0     8700    3       -1.0
000538  MPC     8700    8709    3       1.0     8700    3       -1.0
000539  MPC     8700    8710    3       1.0     8700    3       -1.0
000540  MPC     8700    8711    3       1.0     8700    3       -1.0
000541  $               MODAL COORDINATE DATA
000542  SPOINT  101     THRU    109
000543  CMASS4  101     2.927   101
000544  CMASS4  102     2.927   102
000545  CMASS4  103     0.664   103
000546  CMASS4  104     1.311   104
000547  CMASS4  105     0.444   105
000548  CMASS4  106     0.2018  106
000549  CMASS4  107     0.1584  107
000550  CMASS4  108     0.1940  108
000551  CMASS4  109     0.2043  109
000552  CELAS4  204     1.251E6 104
000553  CELAS4  205     1.262E6 105
000554  CELAS4  206     7.457E5 106
000555  CELAS4  207     6.729E5 107
000556  CELAS4  208     8.818E5 108
000557  CELAS4  209     9.914E5 109
000558  $          THESE ARE THE MPC'S FOR THE MODAL CONSTRAINTS
000559  $               MODAL CONSTRAINT EQUATIONS
000560  $*************************************************************************
000561  $
000562  $                       GIMBAL  ACTUATORS
000563  $
000564  CELAS2  8301    1.15E6  6130    1       8300    1
000565  CELAS2  8401    1.15E6  6080    1       8400    1
000566  $*************************************************************************
000567  $
000568  $               T P A   STRUCTURE USED FOR ALL MINI-TANK RUNS
000569  $
000570  $               T P A   # 1
000571  GRID    6061    8000    35.0    -90.    43.             456
000572  CONM2   9007    6061            1.97
000573  CELAS2  60611   2.0E+6  6061    1       6070    1
000574  CELAS2  606121  2.0E+6  6061    2       6070    2
000575  CELAS2  606122  1.4E+6  6061    2       6040    2
000576  CELAS2  606131  2.0E+6  6061    3       6070    3
000577  CELAS2  606132  1.4E+6  6061    3       6040    3
000578  $
000579  $               T P A   # 2
000580  GRID    6062    8000    35.0     90.    43.             456
000581  CONM2   9008    6062            1.97
000582  CELAS2  60621   2.0E+6  6062    1       6070    1
000583  CELAS2  606221  2.0E+6  6062    2       6070    2
000584  CELAS2  606222  1.4E+6  6062    2       6040    2
000585  CELAS2  606231  2.0E+6  6062    3       6070    3
000586  CELAS2  606232  1.4E+6  6062    3       6040    3
000587  $*************************************************************************
000588  $
000589  $                       EOS SUPPORT FRAME
000590  $
000591  CELAS2  3055    3.5E6   3050    1       3051
000592  CELAS2  3056    3.5E6   3050    2       3052
000593  CELAS2  3057    3.5E6   3050    3       3053
000594  CELAS2  3058    4.0E7   3050    4
000595  CELAS2  6001    3.5E6   6000    1       6001
000596  CELAS2  6002    3.5E6   6000    2       6002
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000597          CELAS2  6003    3.5E6   6000    3       6003
000598          CELAS2  6004    4.0E7   6000    4
000599          CELAS2  8701    1.E6    8700    1
000600          CELAS2  8702    1.E6    8700    2
000601          CELAS2  8703    1.E6    8700    3
000602          CONM2   8700    8700            1.E6
000603          MPC     8700    3051    0       1.0     8700    1       -1.0
000604          MPC     8700    3052    0       1.0     8700    2       -1.0
000605          MPC     8700    3053    0       1.0     8700    3       -1.0
000606          MPC     8700    6001    0       1.0     8700    1       -1.0
000607          MPC     8700    6002    0       1.0     8700    2       -1.0
000608          MPC     8700    6003    0       1.0     8700    3       -1.0
000609          SPOINT  3051    3052    3053    6001    6002    6003
000610          $*******************************************************************************
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@ ELT EOS/CASE1,1,720223, 38566

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000001          BAROR                                   1000.0  1000.0  0.0     1
000002          $*************************************************************************
000003          $
000004          $                       COORDINATE SYSTEM DEFINITIONS
000005          $
000006          CORD2C  2               256.1   .0      .0      300.    .0      .0      BC
000007          +BC     300.0   -50.0   0.0
000008          CORD2C  8000            0.0     0.0     0.0     1000.0  0.0     0.0     CYL
000009          +CYL    1000.0  1000.0  0.0
000010          $*************************************************************************
000011          $
000012          $       SUPORT CARD FOR RIGID BODY MODES
000013          $
000014          $*************************************************************************
000015          $
000016          $                       EIGENVALUE EXTRACTION
000017          $
000018          EIGR    25      GIV                             25              1.E-6   GIV25
000019          +GIV25  MAX
000020          $*************************************************************************
000021          $
000022          $                       SINGLE-POINT CONSTRAINT SETS
000023          $
000024          SPC1    10      123456  8700
000025          $*************************************************************************
000026          $
000027          $                               MULTI-POINT CONSTRAINTS
000028          $
000029          MPCADD  10      6062    7000    7010    8300    8700
000030          $
000031          $           MPC TPA #2 TO TPA #1
000032          MPC     6062    6062    1       1.0     6061    1       -1.0
000033          MPC     6062    6062    2       1.0     6061    2       -1.0
000034          MPC     6062    6062    3       1.0     6061    3       -1.0
000035          MPC     7000    7000    1       1.0     6070    1       -1.0            7000X
000036          +7000X          6070    5       10.25
000037          MPC     7000    7000    2       1.0     6070    2       -1.0            7000Y
000038          +7000Y          6070    4       -10.25  6070    6       6.0
000039          MPC     7000    7000    3       1.0     6070    3       -1.0            7000Z
000040          +7000Z          6070    5       -6.0
000041          MPC     7000    7000    4       1.0     6070    4       -1.0
000042          MPC     7000    7000    5       1.0     6070    5       -1.0
000043          MPC     7000    7000    6       1.0     6070    6       -1.0
000044          MPC     7010    7010    1       1.0     6070    1       -1.0            7010X
000045          +7010X          6070    5       -10.25
000046          MPC     7010    7010    2       1.0     6070    2       -1.0            7010Y
000047          +7010Y          6070    4       10.25   6070    6       6.0
000048          MPC     7010    7010    3       1.0     6070    3       -1.0            7010Z
000049          +7010Z          6070    5       -6.0
000050          MPC     7010    7010    4       1.0     6070    4       -1.0
000051          MPC     7010    7010    5       1.0     6070    5       -1.0
000052          MPC     7010    7010    6       1.0     6070    6       -1.0
000053          MPC     8300    6080    1       1.0     6050    1       -1.0            6080A
000054          +6080A          6050    5       -20.48  6050    6       -14.34
000055          MPC     8300    6130    1       1.0     6050    1       -1.0            6130A
000056          +6130A          6050    5       14.34   6050    6       -20.48
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000057          MPC     8300    8300    1       1.0     8170    1       -1.0
000058          MPC     8300    8400    1       1.0     8080    1       -1.0
000059          $*************************************************************************
000060          $
000061          $                       OMITTED COORDINATE SET
000062          $
000063          OMIT1   123456  2020    3010    3030    3040    4025    8000    8001    6DOFA
000064          +6DOFA  8002    8005    8010    8020    8021    8022    8160    8030    6DOFB
000065          +6DOFB  8110    8130    8140    4010
000066          OMIT1   456     2000    8170    2040    3000    8210    3020    8180    3DOFA
000067          +3DOFA  8190    4000    8150    4020    8200    4030    5000    6000    3DOFB
000068          +3DOFB  6020    6030    6040    6070    7020    7030    7040    8040    3DOFC
000069          +3DOFC  8050    8060    8070    8080    8090    8100    8120
000070          $*************************************************************************
000071          $
000072          $                           PARAM CARDS
000073          $
000074          PARAM   GRDPNT  0
000075          $*************************************************************************
000076          $
000077          $               GLOBAL AXES FOR PLOT ORIENTATION
000078          $
000079          GRID    1               430.                            123456
000080          GRID    2                       50.                     123456
000081          GRID    3                               50.             123456
000082          GRID    10              420.                            123456
000083          GRID    20                      40.                     123456
000084          GRID    30                              40.             123456
000085          PLOTEL  9001    10      1
000086          PLOTEL  9002    20      2
000087          PLOTEL  9003    30      3
000088          PLOTEL  9010    8120    8005            9011    8005    8025
000089          PLOTEL  9012    8025    8150            9013    8150    8140
000090          PLOTEL  9014    8140    8130            9015    8130    8120
000091          PLOTEL  9020    8200    8050            9021    8050    8040
000092          PLOTEL  9022    8040    8060            9023    8060    8110
000093          PLOTEL  9024    8110    8160            9025    8160    8200
000094          $*************************************************************************
000095          $
000096          $       C O N C E N T R A T E D   M A S S   I T E M S
000097          $
000098          $                       P   F   S
000099          CONM2   9001    2050    2       0.15    28.82   17.6    -2.09
000100          CONM2   9002    5010            .037    -3.36   12.4    7.12
000101          CONM2   9003    5010            1.19    -2.82   .0      .0
000102          CONM2   9004    6060            0.98    2.42    -26.1   .0
000103          CONM2   9005    6050            .86     -1.5    26.5    14.5
000104          CONM2   9006    6050            0.92    4.50    27.5    0.0
000105          $               DESTRUCT SUBSYSTEM
000106          $
000107          $               NOZZLE TO EXTENSION ATTACHMENT
000108          CONM2   2051    2050            .0855                           NEA
000109          +NEA    72.             36.                     36.
000110          $               CORE SUPPORT
000111          CONM2   3051    3050            0.668   -4.93                   CS
000112          +CS     328.            170.                    170.
000113          $               FLANGE
000114          CONM2   3052    3050            1.08    2.07                    FLANGE
000115          +FLANGE 594.            298.                    298.
000116          $               AFT RING
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000117  CONM2   2052    2050            0.40                                    RING
000118  +RING   335.            168.                    168.
000119  $               TORUS
000120  CONM2   2053    2050            0.198   -3.11                           TORUS
000121  +TORUS  181.            91.                     91.
000122  $               NOZZLE TO PV BOLTS
000123  CONM2   3057    3050            .096    1.07                            BOLTS
000124  +BOLTS  51.15           25.65                   25.65
000125  $               CONTROL DRUM ACTUATORS (18)
000126  CONM2   5011    5010    8000    .0344   24.5    10.
000127  CONM2   5012    5010    8000    .0344   24.5    30.
000128  CONM2   5013    5010    8000    .0344   24.5    50.
000129  CONM2   5014    5010    8000    .0344   24.5    70.
000130  CONM2   5015    5010    8000    .0344   24.50   90.
000131  CONM2   5016    5010    8000    .0344   24.50   110.
000132  CONM2   5017    5010    8000    .0344   24.50   130.
000133  CONM2   5018    5010    8000    .0344   24.50   150.
000134  CONM2   5019    5010    8000    .0344   24.50   170.
000135  CONM2   50110   5010    8000    .0344   24.50   190.
000136  CONM2   50111   5010    8000    .0344   24.50   210.
000137  CONM2   50112   5010    8000    .0344   24.50   230.
000138  CONM2   50113   5010    8000    .0344   24.50   250.
000139  CONM2   50114   5010    8000    .0344   24.50   270.
000140  CONM2   50115   5010    8000    .0344   24.50   290.
000141  CONM2   50116   5010    8000    .0344   24.50   310.
000142  CONM2   50117   5010    8000    .0344   24.50   330.
000143  CONM2   50118   5010    8000    .0344   24.50   350.
000144  $               SHIELD
000145  CONM2   6010    6010            25.06   1.67                            SHIELD
000146  +SHIELD 29743.          14957.                  14957.
000147  $               NOICE
000148  CONM2   6021    6020            1.55
000149  $                       ACTUATORS
000150  CONM2   60801   6080            0.24
000151  CONM2   61301   6130            0.24
000152  CONM2   83001   8300            0.24
000153  CONM2   84001   8400            0.24
000154  $                       SIMPLE NSS
000155  CONM2   4001    4001            29.
000156  CONM2   4002    4002            6.02
000157  CONM2   4003    4003            2.90
000158  $*************************************************************************
000159  $
000160  $       COMPONENT NO. 2         NOZZLE EXTENSION
000161  $
000162  CBAR    2020    2020    2020    2000
000163  CBAR    2040    2040    2040    2020
000164  CBAR    2050    2050    2050    2040
000165  GRID    2000            409.372
000166  GRID    2020            351.543
000167  GRID    2040            296.865
000168  GRID    2050            270.190
000169  MAT1    100     1.7E6   0.70E6          1.355E-4
000170  PBAR    2020    100     40.865  55550.  55550.  111100. .00445
000171  PBAR    2040    100     33.253  30250.  30250.  60500.  .00445
000172  PBAR    2050    100     50.047  25400.  25400.  50800.  .00445
000173  $*************************************************************************
000174  $
000175  $       COMPONENT NO. 3         NOZZLE
000176  $
```

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000177          CBAR    3000    3000    3000    2050
000178          CBAR    3010    3010    3010    3000
000179          CBAR    3020    3020    3020    3010
000180          CBAR    3030    3030    3030    3020
000181          CBAR    3040    3040    3040    3030
000182          CBAR    3050    3050    3050    3040
000183          GRID    3000            254.218
000184          GRID    3010            233.25
000185          GRID    3020            225.90
000186          GRID    3030            220.491
000187          GRID    3040            213.236
000188          GRID    3050            206.93
000189          MAT1    347     29.3E6  11.4E6          7.394E-4
000190          PBAR    3000    347     11.5    3414.   3414.   6828.   .007
000191          PBAR    3010    347     32.3    4371.   4371.   8742.   .007
000192          PBAR    3020    347     16.3    567.    567.    1133.   .007
000193          PBAR    3030    347     13.7    333.    333.    666.    .007
000194          PBAR    3040    347     25.2    2070.   2070.   4140.   .007
000195          PBAR    3050    347     82.2    16170.  16170.  32340.  .007
000196          $*************************************************************************
000197          $
000198          $       NUCLEAR SUBSYSTEM           SIMPLE MODEL
000199          $
000200          CELAS2  40011   41.8E6  4001    1       3050    1
000201          CELAS2  40012   9.41E6  4001    2       3050    2
000202          CELAS2  40013   9.41E6  4001    3       3050    3
000203          CELAS2  40021   334.E6  4002    1       4001    1
000204          CELAS2  40022   61.7E6  4002    2       4001    2
000205          CELAS2  40023   61.7E6  4002    3       4001    3
000206          CELAS2  40031   0.48E6  4003    1       4002    1
000207          CELAS2  40032   16.5E6  4003    2       4002    2
000208          CELAS2  40033   16.5E6  4003    3       4002    3
000209          GRID    4001            170.0                           456
000210          GRID    4002            129.0                           456
000211          GRID    4003            124.0                           456
000212          $*************************************************************************
000213          $
000214          $       COMPONENT NO. 4           PRESSURE VESSEL
000215          $
000216          CBAR    4000    4000    4000    3050
000217          CBAR    4010    4000    4010    4000
000218          CBAR    4020    4000    4020    4010
000219          CBAR    4025    4000    4025    4020
000220          CBAR    4030    4000    4030    4025
000221          GRID    4000            185.5175
000222          GRID    4010            164.105
000223          GRID    4020            142.6925
000224          GRID    4025            124.67
000225          GRID    4030            121.28
000226          MAT1    7075    10.3E6  3.9E6           2.616E-4
000227          PBAR    4000    7075    139.933 51600.  51600.  103200. .0114
000228          $*************************************************************************
000229          $
000230          $       COMPONENT NO. 5           PRESSURE VESSEL CLOSURE
000231          $
000232          CBAR    5000    5000    5000    4030
000233          CBAR    5010    5010    5010    5000
000234          GRID    5000            115.97
000235          GRID    5010            110.28
000236          PBAR    5000    7075    233.1   81850.  81850.  163700. .0545
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000237  PBAR    5010    7075    290.28  64000.  64000.  12800.  .0545
000238  $*************************************************************************
000239  $
000240  $       CONPONENT NO.6          LOWER THRUST STRUCTURE
000241  $
000242  CBAR    6000    6000    6000    5010
000243  CBAR    6010    6000    6010    6000
000244  CBAR    6020    6000    6020    6010
000245  CBAR    6030    6000    6030    6020
000246  CBAR    6040    6040    6040    6030
000247  CBAR    6050    6050    6050    6040
000248  CBAR    6060    6060    6060    6050
000249  CBAR    6070    6070    6070    6060
000250  GRID    6000            98.0
000251  GRID    6010            86.33
000252  GRID    6020            74.50
000253  GRID    6030            68.58
000254  GRID    6040            57.0
000255  GRID    6050            39.5
000256  GRID    6060            32.38
000257  GRID    6070            29.0
000258  GRID    6080    8000    25.0    125.0   39.50           23456
000259  GRID    6130    8000    25.0    215.0   39.50           23456
000260  MAT1    7039    10.1E6  3.78E6          2.56E-4
000261  PBAR    6000    7039    11.94   2155.   2155.   4310.   .0282
000262  PBAR    6040    7039    11.64   1989.   1989.   3978.   .0282
000263  PBAR    6050    7039    10.681  1543.   1543.   3087.   .0282
000264  PBAR    6060    7039    9.90    1228.   1228.   2456.   .0282
000265  PBAR    6070    7039    9.58    1114.   1114.   2228.   .0282
000266  $*************************************************************************
000267  $
000268  $       CONPONENT NO. 7         GIMBAL
000269  $
000270  CBAR    7031    7031    7030    7000    0.0     10.0    -10.0   1       7031
000271  +7031           4
000272  CBAR    7032    7031    7030    7040    0.0     10.0    10.0    1       7032
000273  +7032           4
000274  CBAR    7033    7031    7030    7010    0.0     -10.0   10.0    1       7033
000275  +7033           4
000276  CBAR    7034    7031    7030    7020    0.0     -10.0   -10.0   1       7034
000277  +7034           4
000278  CONROD  7021    7020    8001    250     2.0
000279  CONROD  7022    7020    8010    250     2.0
000280  CONROD  7023    7020    8002    250     2.0
000281  CONROD  7024    7020    8000    250     2.0
000282  CONROD  7041    7040    8030    250     2.0
000283  CONROD  7042    7040    8021    250     2.0
000284  CONROD  7043    7040    8022    250     2.0
000285  CONROD  7044    7040    8020    250     2.0
000286  CTRIA2  7121    8012    8000    8005    7020
000287  CTRIA2  7122    8012    8001    8005    7020
000288  CTRIA2  7123    8012    8002    8005    7020
000289  CTRIA2  7124    8012    8010    8005    7020
000290  CTRIA2  7125    8012    8001    8000    7020
000291  CTRIA2  7126    8012    8000    8002    7020
000292  CTRIA2  7127    8012    8002    8010    7020
000293  CTRIA2  7128    8012    8010    8001    7020
000294  CTRIA2  7141    8012    8020    8025    7040
000295  CTRIA2  7142    8012    8021    8025    7040
000296  CTRIA2  7143    8012    8022    8025    7040
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000297          CTRIA2  7144    8012    8030    8025    7040
000298          CTRIA2  7145    8012    8021    8020    7040
000299          CTRIA2  7146    8012    8020    8022    7040
000300          CTRIA2  7147    8012    8022    8030    7040
000301          CTRIA2  7148    8012    8030    8021    7040
000302          GRID    7000            23.0    0.0     -10.25
000303          GRID    7010            23.0    0.0     10.25
000304          GRID    7020            23.0    -10.25  0.0
000305          GRID    7030            23.0    0.0     0.0
000306          GRID    7040            23.0    10.25   0.0
000307          MAT1    250     24.0E6  9.24E6          7.33E-4
000308          PBAR    7031    250     3.0     10.0    10.0    20.0
000309          $*************************************************************************
000310          $
000311          $       COMPONENT NO. 8          UPPER THRUST STRUCTURE
000312          $
000313          CBAR    8000    8000    8090    8000    8160    0       0       2
000314          CBAR    8001    8000    8001    8040    8110    0       0       2
000315          CBAR    8002    8000    8170    8002    8110    0       0       2
000316          CBAR    8010    8000    8010    8050    8160    0       0       2
000317          CBAR    8021    8000    8021    8100    8140    0       0       2
000318          CBAR    8022    8000    8050    8022    8140    0       0       2
000319          CBAR    8030    8000    8030    8180    8140    0       0       2
000320          CBAR    8040    8000    8040    8020    8140    0       0       2
000321          CBAR    8050    8000    8050    8210    8160    0       0       2
000322          CBAR    8052    8000    8190    8050    8140    0       0       2
000323          CBAR    8061    8170    8060    8080    -10.0   -10.    0.0     1       8061
000324          +8061                   -3.4                    -3.4
000325          CBAR    8065    8190    8060    8080    -10.0   -10.0   0.0     1       8065
000326          +8065                   -2.5                    -2.5
000327          CBAR    8072    8000    8040    8070    8110    0       0       2
000328          CBAR    8073    8170    8070    8060    -10.0   -10.    0.0     1       8073
000329          +8073                   -3.4                    -3.4
000330          CBAR    8075    8190    8070    8060    -10.0   -10.0   0.0     1       8075
000331          +8075                   -2.5                    -2.5
000332          CBAR    8081    8000    8080    8040    8140    0       0       2
000333          CBAR    8085    8190    8080    8090    -10.0   -10.0   -10.0   1       8085
000334          +8085                   -2.5                    -2.5
000335          CBAR    8095    8190    8090    8120    -10.0   -3.75   -14.0   1       8095
000336          +8095                   -2.5                    -2.5
000337          CBAR    8105    8190    8100    8070    -10.0   -10.    10.     1       8105
000338          +8105                   -2.5                    -2.5
000339          CBAR    8125    8190    8120    8170    -10.0   3.75    -14.0   1       8125
000340          +8125                   -2.5                    -2.5
000341          CBAR    8155    8190    8150    8100    -10.0   -3.75   14.0    1       8155
000342          +8155                   -2.5                    -2.5
000343          CBAR    8171    8170    8170    8090    -10.0   0.0     10.0    1       8171
000344          +8171                   -3.4                    -3.4
000345          CBAR    8175    8190    8170    8190    -10.0   10.0    -10.0   1       8175
000346          +8175                   -2.5                    -2.5
000347          CBAR    8181    8170    8180    8100    -10.0   0.0     10.0    1       8181
000348          +8181                   -3.4                    -3.4
000349          CBAR    8185    8190    8180    8150    -10.0   3.75    14.0    1       8185
000350          +8185                   -2.5                    -2.5
000351          CBAR    8191    8170    8190    8200    -10.    10.     0.      1       8191
000352          +8191                   -3.4                    -3.4
000353          CBAR    8195    8190    8190    8200    -10.0   10.0    0.0     1       8195
000354          +8195                   -2.5                    -2.5
000355          CBAR    8201    8170    8200    8210    -10.    10.     0.      1       8201
000356          +8201                   -3.4                    -3.4
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000357  CBAR    8205    8190    8200    8210    -10.0   10.0    0.0     1       8205
000358  +8205                   -2.5                    -2.5
000359  CBAR    8215    8190    8210    8180    -10.0   10.     10.     1       8215
000360  +8215                   -2.5                    -2.5
000361  CQDMEM  8006    8006    8040    8110    8130    8001
000362  CQDMEM  8011    8006    8050    8160    8130    8010
000363  CQDMEM  8043    8006    8040    8110    8140    8020
000364  CQDMEM  8192    8006    8050    8160    8140    8022
000365  CROD    8041    8041    8040    8110    8051    8041    8050    8160
000366  CROD    8071    8130    8110    8070    8161    8130    8190    8160
000367  CROD    8111    8130    8110    8140    8140    8130    8140    8180
000368  CROD    8130    8130    8090    8130    8160    8130    8130    8160
000369  CROD    8162    8130    8160    8140    8163    8130    8140    8100
000370  CROD    8171    8130    8170    8130    8131    8130    8130    8110
000371  CROD    8210    8130    8160    8210    8110    8130    8080    8110
000372  CTRIA2  8001    8001    8000    8130    8090
000373  CTRIA2  8002    8002    8005    8130    8000
000374  CTRIA2  8003    8002    8005    8130    8010
000375  CTRIA2  8004    8001    8002    8130    8170
000376  CTRIA2  8005    8002    8005    8130    8002
000377  CTRIA2  8007    8001    8040    8110    8070
000378  CTRIA2  8008    8002    8005    8130    8001
000379  CTRIA2  8012    8012    8000    8001    8005
000380  CTRIA2  8013    8012    8001    8010    8005
000381  CTRIA2  8014    8012    8010    8002    8005
000382  CTRIA2  8015    8012    8002    8000    8005
000383  CTRIA2  8026    8002    8025    8140    8020
000384  CTRIA2  8027    8002    8025    8140    8030
000385  CTRIA2  8031    8001    8030    8140    8100
000386  CTRIA2  8032    8012    8021    8030    8025
000387  CTRIA2  8033    8012    8030    8022    8025
000388  CTRIA2  8034    8012    8022    8020    8025
000389  CTRIA2  8036    8012    8020    8021    8025
000390  CTRIA2  8052    8001    8050    8160    8210
000391  CTRIA2  8082    8001    8040    8110    8080
000392  CTRIA2  8121    8001    8090    8120    8170
000393  CTRIA2  8151    8001    8100    8150    8180
000394  CTRIA2  8191    8001    8050    8160    8190
000395  CTRIA2  8193    8002    8025    8140    8022
000396  CTRIA2  8194    8002    8025    8140    8021
000397  CTRIA2  8195    8001    8021    8140    8100
000398  GRID    8000            17.0    -13.25  3.0
000399  GRID    8001            17.0    -7.25   3.0
000400  GRID    8002            17.0    -13.25  -3.0
000401  GRID    8005            17.0    -10.25  0.0
000402  GRID    8010            17.0    -7.25   -3.0
000403  GRID    8020            17.0    7.25    3.0
000404  GRID    8021            17.0    13.25   3.0
000405  GRID    8022            17.0    7.25    -3.0
000406  GRID    8025            17.0    10.25   0.0
000407  GRID    8030            17.0    13.25   -3.0
000408  GRID    8040            17.0    0.0     10.25
000409  GRID    8050            17.0    0.0     -10.25
000410  GRID    8060            0.0     0.0     24.25
000411  GRID    8070    8000    28.0    60.     0.0
000412  GRID    8080    8000    28.0    120.    0.0
000413  GRID    8090    8000    28.0    150.    0.0
000414  GRID    8100    8000    28.0    30.     0.0
000415  GRID    8110            0.0     0.0     10.25
000416  GRID    8120    8000    28.0    180.    .0
```

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000417          GRID    8130            0.0     -10.25  .0
000418          GRID    8140            0.0     10.25   .0
000419          GRID    8150    8000    28.0    .0      .0
000420          GRID    8160            0.0     .0      -10.25
000421          GRID    8170    8000    28.0    -150.   .0
000422          GRID    8180    8000    28.0    -30.    .0
000423          GRID    8190    8000    28.0    -120.   .0
000424          GRID    8200            0.0     .0      -24.25
000425          GRID    8210    8000    28.0    -60.    .0
000426          GRID    8300    8000    25.0    215.0   0.0     0       23456
000427          GRID    8400    8000    25.0    125.0   0.0     0       23456
000428          MAT1    2024    10.5E6  4.0E6           2.6E-4
000429          PBAR    8000    2024    1.17    .08     .26
000430          PBAR    8170    2024    0.50    4.3     .0002
000431          PBAR    8190    2024    .8      2.36    2.36    3.55
000432          PQDMEM  8006    2024    0.10
000433          PROD    8041    2024    0.35
000434          PROD    8130    2024    0.435
000435          PTRIA2  8001    2024    0.064
000436          PTRIA2  8002    2024    0.20
000437          PTRIA2  8012    2024    .125
000438          $*************************************************************************
000439          $
000440          $                       M I N I - T A N K
000441          $*************************************************************************
000442          $
000443          $                       GIMBAL  ACTUATORS
000444          $
000445          CELAS2  8301    1.15E6  6130    1       8300    1
000446          CELAS2  8401    1.15E6  6080    1       8400    1
000447          $*************************************************************************
000448          $
000449          $               T P A   STRUCTURE USED FOR ALL MINI-TANK RUNS
000450          $
000451          $               T P A   # 1
000452          GRID    6061    8000    35.0    -90.    43.             456
000453          CONM2   9007    6061            1.97
000454          CELAS2  60611   2.0E+6  6061    1       6070    1
000455          CELAS2  606121  2.0E+6  6061    2       6070    2
000456          CELAS2  606122  1.4E+6  6061    2       6040    2
000457          CELAS2  606131  2.0E+6  6061    3       6070    3
000458          CELAS2  606132  1.4E+6  6061    3       6040    3
000459          $
000460          $               T P A   # 2
000461          GRID    6062    8000    35.0     90.    43.             456
000462          CONM2   9008    6062            1.97
000463          CELAS2  60621   2.0E+6  6062    1       6070    1
000464          CELAS2  606221  2.0E+6  6062    2       6070    2
000465          CELAS2  606222  1.4E+6  6062    2       6040    2
000466          CELAS2  606231  2.0E+6  6062    3       6070    3
000467          CELAS2  606232  1.4E+6  6062    3       6040    3
000468          $*************************************************************************
000469          $
000470          $                       EOS SUPPORT FRAME
000471          $
000472          CELAS2  3055    3.5E+6  3050    1       3051    1                       *NEW
000473          CELAS2  3056    3.5E+6  3050    2       3051    2                       *NEW
000474          CELAS2  3057    3.5E+6  3050    3       3051    3                       *NEW
000475          CELAS2  3058    4.0E+7  3050    4                                       *NEW
000476          CELAS2  6001    3.5E+6  6000    1       6001    1                       *NEW
```

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000477          CELAS2  6002    3.5E+6  6000    2       6001    2                               *NEW
000478          CELAS2  6003    3.5E+6  6000    3       6001    3                               *NEW
000479          CELAS2  6004    4.0E+7  6000    4                                               *NEW
000480          CELAS2  8701    1.E+6   6001    1                                               *NEW
000481          CELAS2  8702    1.E+6   6001    2                                               *NEW
000482          CELAS2  8703    1.E+6   6001    3                                               *NEW
000483          CONM2   6001    6001            1.E+6                                           *NEW
000484          GRID    3051            206.63                          456                     *NEW
000485          GRID    6001            98.                             456                     *NEW
000486          MPC     8700    3051    1       1.0     6001    1       -1.0                    *NEW
000487          MPC     8700    3051    2       1.0     6001    2       -1.0                    *NEW
000488          MPC     8700    3051    3       1.0     6001    3       -1.0                    *NEW
000489          $*******************************************************************************-20
```

APPENDIX A

CASE 2

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@ ELT EOS/CASE2,1,720223, 39680

```
000001  BAROR                                   1000.0  1000.0  0.0     1
000002  $*************************************************************************
000003  $
000004  $                       COORDINATE SYSTEM DEFINITIONS
000005  $
000006  CORD2C  2               256.1   .0      .0      300.    .0      .0      BC
000007  +BC     300.0   -50.0   0.0
000008  CORD2C  8000            0.0     0.0     0.0     1000.0  0.0     0.0     CYL
000009  +CYL    1000.0  1000.0  0.0
000010  $*************************************************************************
000011  $
000012  $       SUPORT CARD FOR RIGID BODY MODES
000013  $
000014  $*************************************************************************
000015  $
000016  $                       EIGENVALUE EXTRACTION
000017  $
000018  EIGR    25      GIV                             25              1.E-6   GIV25
000019  +GIV25  MAX
000020  $*************************************************************************
000021  $
000022  $                       SINGLE-POINT CONSTRAINT SETS
000023  $
000024  SPC1    10      123456  8700
000025  $*************************************************************************
000026  $
000027  $                               MULTI-POINT CONSTRAINTS
000028  $
000029  MPCADD  10      6062    7000    7010    8300    8700
000030  $
000031  $           MPC TPA #2 TO TPA #1
000032  MPC     6062    6062    1       1.0     6061    1       -1.0
000033  MPC     6062    6062    2       1.0     6061    2       -1.0
000034  MPC     6062    6062    3       1.0     6061    3       -1.0
000035  MPC     7000    7000    1       1.0     6070    1       -1.0            7000X
000036  +7000X          6070    5       10.25
000037  MPC     7000    7000    2       1.0     6070    2       -1.0            7000Y
000038  +7000Y          6070    4       -10.25  6070    6       6.0
000039  MPC     7000    7000    3       1.0     6070    3       -1.0            7000Z
000040  +7000Z          6070    5       -6.0
000041  MPC     7000    7000    4       1.0     6070    4       -1.0
000042  MPC     7000    7000    5       1.0     6070    5       -1.0
000043  MPC     7000    7000    6       1.0     6070    6       -1.0
000044  MPC     7010    7010    1       1.0     6070    1       -1.0            7010X
000045  +7010X          6070    5       -10.25
000046  MPC     7010    7010    2       1.0     6070    2       -1.0            7010Y
000047  +7010Y          6070    4       10.25   6070    6       6.0
000048  MPC     7010    7010    3       1.0     6070    3       -1.0            7010Z
000049  +7010Z          6070    5       -6.0
000050  MPC     7010    7010    4       1.0     6070    4       -1.0
000051  MPC     7010    7010    5       1.0     6070    5       -1.0
000052  MPC     7010    7010    6       1.0     6070    6       -1.0
000053  MPC     8300    6080    1       1.0     6050    1       -1.0            6080A
000054  +6080A          6050    5       -20.48  6050    6       -14.34
000055  MPC     8300    6130    1       1.0     6050    1       -1.0            6130A
000056  +6130A          6050    5       14.34   6050    6       -20.48
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000057  MPC     8300    8300    1       1.0     8170    1       -1.0
000058  MPC     8300    8400    1       1.0     8080    1       -1.0
000059  $*************************************************************************
000060  $
000061  $                       OMITTED COORDINATE SET
000062  $
000063  OMIT1   123456  2020    3010    3030    3040    4025    8000    8001    6DOFA
000064  +6DOFA  8002    8005    8010    8020    8021    8022    8160    8030    6DOFB
000065  +6DOFB  8110    8130    8140    4010
000066  OMIT1   456     2000    8170    2040    3000    8210    3020    8180    3DOFA
000067  +3DOFA  8190    4000    8150    4020    8200    4030    5000    6000    3DOFB
000068  +3DOFB  6020    6030    6040    6070    7020    7030    7040    8040    3DOFC
000069  +3DOFC  8050    8060    8070    8080    8090    8100    8120
000070  $*************************************************************************
000071  $
000072  $                           PARAM CARDS
000073  $
000074  PARAM   GRDPNT  0
000075  $*************************************************************************
000076  $
000077  $               GLOBAL AXES FOR PLOT ORIENTATION
000078  $
000079  GRID    1               430.                            123456
000080  GRID    2                       50.                     123456
000081  GRID    3                               50.             123456
000082  GRID    10              420.                            123456
000083  GRID    20                      40.                     123456
000084  GRID    30                              40.             123456
000085  PLOTEL  9001    10      1
000086  PLOTEL  9002    20      2
000087  PLOTEL  9003    30      3
000088  PLOTEL  9010    8120    8005            9011    8005    8025
000089  PLOTEL  9012    8025    8150            9013    8150    8140
000090  PLOTEL  9014    8140    8130            9015    8130    8120
000091  PLOTEL  9020    8200    8050            9021    8050    8040
000092  PLOTEL  9022    8040    8060            9023    8060    8110
000093  PLOTEL  9024    8110    8160            9025    8160    8200
000094  $*************************************************************************
000095  $
000096  $       C O N C E N T R A T E D   M A S S   I T E M S
000097  $
000098  $                       P   F   S
000099  CONM2   9001    2050    2       0.15    28.82   17.6    -2.09
000100  CONM2   9002    5010            .037    -3.36   12.4    7.12
000101  CONM2   9003    5010            1.19    -2.82   .0      .0
000102  CONM2   9004    6060            0.98    2.42    -26.1   .0
000103  CONM2   9005    6050            .86     -1.5    26.5    14.5
000104  CONM2   9006    6050            0.92    4.50    27.5    0.0
000105  $               DESTRUCT SUBSYSTEM
000106  $
000107  $               NOZZLE TO EXTENSION ATTACHMENT
000108  CONM2   2051    2050            .0855                           NEA
000109  +NEA    72.             36.                     36.
000110  $               CORE SUPPORT
000111  CONM2   3051    3050            0.668   -4.93                   CS
000112  +CS     328.            170.                    170.
000113  $               FLANGE
000114  CONM2   3052    3050            1.08    2.07                    FLANGE
000115  +FLANGE 594.            298.                    298.
000116  $               AFT RING
```

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000117 CONM2   2052    2050            0.40                                    RING
000118 +RING   335.            168.                    168.
000119 $               TORUS
000120 CONM2   2053    2050            0.198   -3.11                           TORUS
000121 +TORUS  181.            91.                     91.
000122 $               NOZZLE TO PV BOLTS
000123 CONM2   3057    3050            .096    1.07                            BOLTS
000124 +BOLTS  51.15           25.65                   25.65
000125 $               CONTROL DRUM ACTUATORS (18)
000126 CONM2   5011    5010    8000    .0344   24.5    10.
000127 CONM2   5012    5010    8000    .0344   24.5    30.
000128 CONM2   5013    5010    8000    .0344   24.5    50.
000129 CONM2   5014    5010    8000    .0344   24.5    70.
000130 CONM2   5015    5010    8000    .0344   24.50   90.
000131 CONM2   5016    5010    8000    .0344   24.50   110.
000132 CONM2   5017    5010    8000    .0344   24.50   130.
000133 CONM2   5018    5010    8000    .0344   24.50   150.
000134 CONM2   5019    5010    8000    .0344   24.50   170.
000135 CONM2   50110   5010    8000    .0344   24.50   190.
000136 CONM2   50111   5010    8000    .0344   24.50   210.
000137 CONM2   50112   5010    8000    .0344   24.50   230.
000138 CONM2   50113   5010    8000    .0344   24.50   250.
000139 CONM2   50114   5010    8000    .0344   24.50   270.
000140 CONM2   50115   5010    8000    .0344   24.50   290.
000141 CONM2   50116   5010    8000    .0344   24.50   310.
000142 CONM2   50117   5010    8000    .0344   24.50   330.
000143 CONM2   50118   5010    8000    .0344   24.50   350.
000144 $               SHIELD
000145 $                                S H I E L D   R E M O V E D
000146 OMIT1   456     6010
000147 $               NDICE
000148 CONM2   6021    6020            1.55
000149 $                               ACTUATORS
000150 CONM2   60801   6080            0.24
000151 CONM2   61301   6130            0.24
000152 CONM2   83001   8300            0.24
000153 CONM2   84001   8400            0.24
000154 $                               SIMPLE NSS
000155 CONM2   4001    4001            29.
000156 CONM2   4002    4002            6.02
000157 CONM2   4003    4003            2.90
000158 $*************************************************************************
000159 $
000160 $       COMPONENT NO. 2         NOZZLE EXTENSION
000161 $
000162 CBAR    2020    2020    2020    2000
000163 CBAR    2040    2040    2040    2020
000164 CBAR    2050    2050    2050    2040
000165 GRID    2000            409.372
000166 GRID    2020            351.543
000167 GRID    2040            296.865
000168 GRID    2050            270.190
000169 MAT1    100     1.7E6   0.70E6          1.355E-4
000170 PBAR    2020    100     40.865  55550.  55550.  111100. .00445
000171 PBAR    2040    100     33.253  30250.  30250.  60500.  .00445
000172 PBAR    2050    100     50.047  25400.  25400.  50800.  .00445
000173 $*************************************************************************
000174 $
000175 $       COMPONENT NO. 3         NOZZLE
000176 $
```

```
000177         CBAR    3000    3000    3000    2050
000178         CBAR    3010    3010    3010    3000
000179         CBAR    3020    3020    3020    3010
000180         CBAR    3030    3030    3030    3020
000181         CBAR    3040    3040    3040    3030
000182         CBAR    3050    3050    3050    3040
000183         GRID    3000            254.218
000184         GRID    3010            233.25
000185         GRID    3020            225.90
000186         GRID    3030            220.491
000187         GRID    3040            213.236
000188         GRID    3050            206.93
000189         MAT1    347     29.3E6  11.4E6          7.394E-4
000190         PBAR    3000    347     11.5    3414.   3414.   6828.   .007
000191         PBAR    3010    347     32.3    4371.   4371.   8742.   .007
000192         PBAR    3020    347     16.3    567.    567.    1133.   .007
000193         PBAR    3030    347     13.7    333.    333.    666.    .007
000194         PBAR    3040    347     25.2    2070.   2070.   4140.   .007
000195         PBAR    3050    347     82.2    16170.  16170.  32340.  .007
000196         $*************************************************************************
000197         $
000198         $       NUCLEAR SUBSYSTEM          SIMPLE MODEL
000199         $
000200         CELAS2  40011   41.8E6  4001    1       3050    1
000201         CELAS2  40012   9.41E6  4001    2       3050    2
000202         CELAS2  40013   9.41E6  4001    3       3050    3
000203         CELAS2  40021   334.E6  4002    1       4001    1
000204         CELAS2  40022   61.7E6  4002    2       4001    2
000205         CELAS2  40023   61.7E6  4002    3       4001    3
000206         CELAS2  40031   0.48E6  4003    1       4002    1
000207         CELAS2  40032   16.5E6  4003    2       4002    2
000208         CELAS2  40033   16.5E6  4003    3       4002    3
000209         GRID    4001            170.0                           456
000210         GRID    4002            129.0                           456
000211         GRID    4003            124.0                           456
000212         $*************************************************************************
000213         $
000214         $       COMPONENT NO. 4           PRESSURE VESSEL
000215         $
000216         CBAR    4000    4000    4000    3050
000217         CBAR    4010    4000    4010    4000
000218         CBAR    4020    4000    4020    4010
000219         CBAR    4025    4000    4025    4020
000220         CBAR    4030    4000    4030    4025
000221         GRID    4000            185.5175
000222         GRID    4010            164.105
000223         GRID    4020            142.6925
000224         GRID    4025            124.67
000225         GRID    4030            121.28
000226         MAT1    7075    10.3E6  3.9E6           2.616E-4
000227         PBAR    4000    7075    139.933 51600.  51600.  103200. .0114
000228         $*************************************************************************
000229         $
000230         $       COMPONENT NO. 5           PRESSURE VESSEL CLOSURE
000231         $
000232         CBAR    5000    5000    5000    4030
000233         CBAR    5010    5010    5010    5000
000234         GRID    5000            115.97
000235         GRID    5010            110.28
000236         PBAR    5000    7075    233.1   81850.  81850.  163700. .0545
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000237 PBAR    5010    7075    290.28  64000.  64000.  12800.  .0545
000238 $*************************************************************************
000239 $
000240 $       CONPONENT NO.6          LOWER THRUST STRUCTURE
000241 $
000242 CBAR    6000    6000    6000    5010
000243 CBAR    6010    6000    6010    6000
000244 CBAR    6020    6000    6020    6010
000245 CBAR    6030    6000    6030    6020
000246 CBAR    6040    6040    6040    6030
000247 CBAR    6050    6050    6050    6040
000248 CBAR    6060    6060    6060    6050
000249 CBAR    6070    6070    6070    6060
000250 GRID    6000            98.0
000251 GRID    6010            86.33
000252 GRID    6020            74.50
000253 GRID    6030            68.58
000254 GRID    6040            57.0
000255 GRID    6050            39.5
000256 GRID    6060            32.38
000257 GRID    6070            29.0
000258 GRID    6080    8000    25.0    125.0   39.50           23456
000259 GRID    6130    8000    25.0    215.0   39.50           23456
000260 MAT1    7039    10.1E6  3.78E6          2.56E-4
000261 PBAR    6000    7039    11.94   2155.   2155.   4310.   .0282
000262 PBAR    6040    7039    11.64   1989.   1989.   3978.   .0282
000263 PBAR    6050    7039    10.681  1543.   1543.   3087.   .0282
000264 PBAR    6060    7039    9.90    1228.   1228.   2456.   .0282
000265 PBAR    6070    7039    9.58    1114.   1114.   2228.   .0282
000266 $*************************************************************************
000267 $
000268 $       COMPONENT NO. 7         GIMBAL
000269 $
000270 CBAR    7031    7031    7030    7000    0.0     10.0    -10.0   1       7031
000271 +7031           4
000272 CBAR    7032    7031    7030    7040    0.0     10.0    10.0    1       7032
000273 +7032           4
000274 CBAR    7033    7031    7030    7010    0.0     -10.0   10.0    1       7033
000275 +7033           4
000276 CBAR    7034    7031    7030    7020    0.0     -10.0   -10.0   1       7034
000277 +7034           4
000278 CONROD  7021    7020    8001    250     2.0
000279 CONROD  7022    7020    8010    250     2.0
000280 CONROD  7023    7020    8002    250     2.0
000281 CONROD  7024    7020    8000    250     2.0
000282 CONROD  7041    7040    8030    250     2.0
000283 CONROD  7042    7040    8021    250     2.0
000284 CONROD  7043    7040    8022    250     2.0
000285 CONROD  7044    7040    8020    250     2.0
000286 CTRIA2  7121    8012    8000    8005    7020
000287 CTRIA2  7122    8012    8001    8005    7020
000288 CTRIA2  7123    8012    8002    8005    7020
000289 CTRIA2  7124    8012    8010    8005    7020
000290 CTRIA2  7125    8012    8001    8000    7020
000291 CTRIA2  7126    8012    8000    8002    7020
000292 CTRIA2  7127    8012    8002    8010    7020
000293 CTRIA2  7128    8012    8010    8001    7020
000294 CTRIA2  7141    8012    8020    8025    7040
000295 CTRIA2  7142    8012    8021    8025    7040
000296 CTRIA2  7143    8012    8022    8025    7040
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000297          CTRIA2  7144    8012    8030    8025    7040
000298          CTRIA2  7145    8012    8021    8020    7040
000299          CTRIA2  7146    8012    8020    8022    7040
000300          CTRIA2  7147    8012    8022    8030    7040
000301          CTRIA2  7148    8012    8030    8021    7040
000302          GRID    7000            23.0    0.0     -10.25
000303          GRID    7010            23.0    0.0     10.25
000304          GRID    7020            23.0    -10.25  0.0
000305          GRID    7030            23.0    0.0     0.0
000306          GRID    7040            23.0    10.25   0.0
000307          MAT1    250     24.0E6  9.24E6          7.33E-4
000308          PBAR    7031    250     3.0     10.0    10.0    20.0
000309          $*************************************************************************
000310          $
000311          $       COMPONENT NO. 8          UPPER THRUST STRUCTURE
000312          $
000313          CBAR    8000    8000    8090    8000    8160    0       0       2
000314          CBAR    8001    8000    8001    8040    8110    0       0       2
000315          CBAR    8002    8000    8170    8002    8110    0       0       2
000316          CBAR    8010    8000    8010    8050    8160    0       0       2
000317          CBAR    8021    8000    8021    8100    8140    0       0       2
000318          CBAR    8022    8000    8050    8022    8140    0       0       2
000319          CBAR    8030    8000    8030    8180    8140    0       0       2
000320          CBAR    8040    8000    8040    8020    8140    0       0       2
000321          CBAR    8050    8000    8050    8210    8160    0       0       2
000322          CBAR    8052    8000    8190    8050    8140    0       0       2
000323          CBAR    8061    8170    8060    8080    -10.0   -10.    0.0     1       8061
000324          +8061                   -3.4                    -3.4
000325          CBAR    8065    8190    8060    8080    -10.0   -10.0   0.0     1       8065
000326          +8065                   -2.5                    -2.5
000327          CBAR    8072    8000    8040    8070    8110    0       0       2
000328          CBAR    8073    8170    8070    8060    -10.0   -10.    0.0     1       8073
000329          +8073                   -3.4                    -3.4
000330          CBAR    8075    8190    8070    8060    -10.0   -10.0   0.0     1       8075
000331          +8075                   -2.5                    -2.5
000332          CBAR    8081    8000    8080    8040    8140    0       0       2
000333          CBAR    8085    8190    8080    8090    -10.0   -10.0   -10.0   1       8085
000334          +8085                   -2.5                    -2.5
000335          CBAR    8095    8190    8090    8120    -10.0   -3.75   -14.0   1       8095
000336          +8095                   -2.5                    -2.5
000337          CBAR    8105    8190    8100    8070    -10.0   -10.    10.     1       8105
000338          +8105                   -2.5                    -2.5
000339          CBAR    8125    8190    8120    8170    -10.0   3.75    -14.0   1       8125
000340          +8125                   -2.5                    -2.5
000341          CBAR    8155    8190    8150    8100    -10.0   -3.75   14.0    1       8155
000342          +8155                   -2.5                    -2.5
000343          CBAR    8171    8170    8170    8090    -10.0   0.0     10.0    1       8171
000344          +8171                   -3.4                    -3.4
000345          CBAR    8175    8190    8170    8190    -10.0   10.0    -10.0   1       8175
000346          +8175                   -2.5                    -2.5
000347          CBAR    8181    8170    8180    8100    -10.0   0.0     10.0    1       8181
000348          +8181                   -3.4                    -3.4
000349          CBAR    8185    8190    8180    8150    -10.0   3.75    14.0    1       8185
000350          +8185                   -2.5                    -2.5
000351          CBAR    8191    8170    8190    8200    -10.    10.     0.      1       8191
000352          +8191                   -3.4                    -3.4
000353          CBAR    8195    8190    8190    8200    -10.0   10.0    0.0     1       8195
000354          +8195                   -2.5                    -2.5
000355          CBAR    8201    8170    8200    8210    -10.    10.     0.      1       8201
000356          +8201                   -3.4                    -3.4
```

000357	CBAR	8205	8190	8200	8210	-10.0	10.0	0.0	1	8205
000358	+8205			-2.5			-2.5			
000359	CBAR	8215	8190	8210	8180	-10.0	10.	10.	1	8215
000360	+8215			-2.5			-2.5			
000361	CQDMEM	8006	8006	8040	8110	8130	8001			
000362	CQDMEM	8011	8006	8050	8160	8130	8010			
000363	CQDMEM	8043	8006	8040	8110	8140	8020			
000364	CQDMEM	8192	8006	8050	8160	8140	8022			
000365	CROD	8041	8041	8040	8110	8051	8041	8050	8160	
000366	CROD	8071	8130	8110	8070	8161	8130	8190	8160	
000367	CROD	8111	8130	8110	8140	8140	8130	8140	8180	
000368	CROD	8130	8130	8090	8130	8160	8130	8130	8160	
000369	CROD	8162	8130	8160	8140	8163	8130	8140	8100	
000370	CROD	8171	8130	8170	8130	8131	8130	8130	8110	
000371	CROD	8210	8130	8160	8210	8110	8130	8080	8110	
000372	CTRIA2	8001	8001	8000	8130	8090				
000373	CTRIA2	8002	8002	8005	8130	8000				
000374	CTRIA2	8003	8002	8005	8130	8010				
000375	CTRIA2	8004	8001	8002	8130	8170				
000376	CTRIA2	8005	8002	8005	8130	8002				
000377	CTRIA2	8007	8001	8040	8110	8070				
000378	CTRIA2	8008	8002	8005	8130	8001				
000379	CTRIA2	8012	8012	8000	8001	8005				
000380	CTRIA2	8013	8012	8001	8010	8005				
000381	CTRIA2	8014	8012	8010	8002	8005				
000382	CTRIA2	8015	8012	8002	8000	8005				
000383	CTRIA2	8026	8002	8025	8140	8020				
000384	CTRIA2	8027	8002	8025	8140	8030				
000385	CTRIA2	8031	8001	8030	8140	8180				
000386	CTRIA2	8032	8012	8021	8030	8025				
000387	CTRIA2	8033	8012	8030	8022	8025				
000388	CTRIA2	8034	8012	8022	8020	8025				
000389	CTRIA2	8036	8012	8020	8021	8025				
000390	CTRIA2	8052	8001	8050	8160	8210				
000391	CTRIA2	8082	8001	8040	8110	8080				
000392	CTRIA2	8121	8001	8090	8120	8170				
000393	CTRIA2	8151	8001	8100	8150	8180				
000394	CTRIA2	8191	8001	8050	8160	8190				
000395	CTRIA2	8193	8002	8025	8140	8022				
000396	CTRIA2	8194	8002	8025	8140	8021				
000397	CTRIA2	8195	8001	8021	8140	8100				
000398	GRID	8000		17.0	-13.25	3.0				
000399	GRID	8001		17.0	-7.25	3.0				
000400	GRID	8002		17.0	-13.25	-3.0				
000401	GRID	8005		17.0	-10.25	0.0				
000402	GRID	8010		17.0	-7.25	-3.0				
000403	GRID	8020		17.0	7.25	3.0				
000404	GRID	8021		17.0	13.25	3.0				
000405	GRID	8022		17.0	7.25	-3.0				
000406	GRID	8025		17.0	10.25	0.0				
000407	GRID	8030		17.0	13.25	-3.0				
000408	GRID	8040		17.0	0.0	10.25				
000409	GRID	8050		17.0	0.0	-10.25				
000410	GRID	8060		0.0	0.0	24.25				
000411	GRID	8070	8000	28.0	60.	0.0				
000412	GRID	8080	8000	28.0	120.	0.0				
000413	GRID	8090	8000	28.0	150.	0.0				
000414	GRID	8100	8000	28.0	30.	0.0				
000415	GRID	8110		0.0	0.0	10.25				
000416	GRID	8120	8000	28.0	180.	.0				

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000417 GRID     8130            0.0     -10.25  .0
000418 GRID     8140            0.0     10.25   .0
000419 GRID     8150    8000    28.0    .0      .0
000420 GRID     8160            0.0     .0      -10.25
000421 GRID     8170    8000    28.0    -150.   .0
000422 GRID     8180    8000    28.0    -30.    .0
000423 GRID     8190    8000    28.0    -120.   .0
000424 GRID     8200            0.0     .0      -24.25
000425 GRID     8210    8000    28.0    -60.    .0
000426 GRID     8300    8000    25.0    215.0   0.0     0       23456
000427 GRID     8400    8000    25.0    125.0   0.0     0       23456
000428 MAT1     2024    10.5E6  4.0E6           2.6E-4
000429 PBAR     8000    2024    1.17    .08     .26
000430 PBAR     8170    2024    0.50    4.3     .0002
000431 PBAR     8190    2024    .8      2.36    2.36    3.55
000432 PODMEM   8006    2024    0.10
000433 PROD     8041    2024    0.35
000434 PROD     8130    2024    0.435
000435 PTRIA2   8001    2024    0.064
000436 PTRIA2   8002    2024    0.20
000437 PTRIA2   8012    2024    .125
000438 $*************************************************************************
000439 $
000440 $                          M I N I - T A N K
000441 $
000442 $*************************************************************************
000443 $
000444 $                          GIMBAL  ACTUATORS
000445 $
000446 CELAS2   8301    1.15E6  6130    1       8300    1
000447 CELAS2   8401    1.15E6  6080    1       8400    1
000448 $*************************************************************************
000449 $
000450 $                  T P A   STRUCTURE USED FOR ALL MINI-TANK RUNS
000451 $
000452 $                  T P A   # 1
000453 GRID     6061    8000    35.0    -90.    43.             456
000454 CONM2    9007    6061            1.97
000455 CELAS2   60611   2.0E+6  6061    1       6070    1
000456 CELAS2   606121  2.0E+6  6061    2       6070    2
000457 CELAS2   606122  1.4E+6  6061    2       6040    2
000458 CELAS2   606131  2.0E+6  6061    3       6070    3
000459 CELAS2   606132  1.4E+6  6061    3       6040    3
000460 $
000461 $                  T P A   # 2
000462 GRID     6062    8000    35.0     90.    43.             456
000463 CONM2    9008    6062            1.97
000464 CELAS2   60621   2.0E+6  6062    1       6070    1
000465 CELAS2   606221  2.0E+6  6062    2       6070    2
000466 CELAS2   606222  1.4E+6  6062    2       6040    2
000467 CELAS2   606231  2.0E+6  6062    3       6070    3
000468 CELAS2   606232  1.4E+6  6062    3       6040    3
000469 $*************************************************************************
000470 $
000471 $                          EOS SUPPORT FRAME
000472 $
000473 CELAS2   3055    3.5E+6  3050    1       3051    1                       *NEW
000474 CELAS2   3056    3.5E+6  3050    2       3051    2                       *NEW
000475 CELAS2   3057    3.5E+6  3050    3       3051    3                       *NEW
000476 CELAS2   3058    4.0E+7  3050    4                                       *NEW
```

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000477 CELAS2  6001    3.5E+6  6000    1       6001    1                       *NEW
000478 CELAS2  6002    3.5E+6  6000    2       6001    2                       *NEW
000479 CELAS2  6003    3.5E+6  6000    3       6001    3                       *NEW
000480 CELAS2  6004    4.0E+7  6000    4                                       *NEW
000481 CELAS2  8701    1.E+6   6001    1                                       *NEW
000482 CELAS2  8702    1.E+6   6001    2                                       *NEW
000483 CELAS2  8703    1.E+6   6001    3                                       *NEW
000484 CONM2   6001    6001            1.E+6                                   *NEW
000485 GRID    3051            206.63                          456             *NEW
000486 GRID    6001            98.                             456             *NEW
000487 MPC     8700    3051    1       1.0     6001    1       -1.0            *NEW
000488 MPC     8700    3051    2       1.0     6001    2       -1.0            *NEW
000489 MPC     8700    3051    3       1.0     6001    3       -1.0            *NEW
000490 $*************************************************************************-20
```

APPENDIX A

CASE 7

@ ELT NSO/CASE7,1,720112, 36743

```
000001          BAROR                                   1000.0  1000.0  0.0     1
000002          $*************************************************************************
000003          $
000004          $                       COORDINATE SYSTEM DEFINITIONS
000005          $
000006          CORD2C  2               256.1   .0      .0      300.    .0      .0      BC
000007          +BC     300.0   -50.0   0.0
000008          CORD2C  8000            0.0     0.0     0.0     1000.0  0.0     0.0     CYL
000009          +CYL    1000.0  1000.0  0.0
000010          $*************************************************************************
000011          $
000012          $       SUPORT CARD FOR RIGID BODY MODES
000013          $
000014          $*************************************************************************
000015          $
000016          $                       EIGENVALUE EXTRACTION
000017          $
000018          EIGR    25      GIV                             25              1.E-6   GIV25
000019          +GIV25  MAX
000020          $*************************************************************************
000021          $
000022          $                       SINGLE-POINT CONSTRAINT SETS
000023          $
000024          SPC1    10      123456  8700
000025          $*************************************************************************
000026          $
000027          $                               MULTI-POINT CONSTRAINTS
000028          $
000029          MPCADD  10      6062    7000    7010    8300    8500    8700                    *NEW
000030          $                                                                               *NEW
000031          $           MPC TPA #2 TO TPA #1                                                *NEW
000032          MPC     6062    6062    1       1.0     6061    1       -1.0                    *NEW
000033          MPC     6062    6062    2       1.0     6061    2       -1.0                    *NEW
000034          MPC     6062    6062    3       1.0     6061    3       -1.0                    *NEW
000035          MPC     7000    7000    1       1.0     6070    1       -1.0            7000X   **-1
000036          +7000X          6070    5       10.25
000037          MPC     7000    7000    2       1.0     6070    2       -1.0            7000Y
000038          +7000Y          6070    4       -10.25  6070    6       6.0
000039          MPC     7000    7000    3       1.0     6070    3       -1.0            7000Z
000040          +7000Z          6070    5       -6.0
000041          MPC     7000    7000    4       1.0     6070    4       -1.0
000042          MPC     7000    7000    5       1.0     6070    5       -1.0
000043          MPC     7000    7000    6       1.0     6070    6       -1.0
000044          MPC     7010    7010    1       1.0     6070    1       -1.0            7010X
000045          +7010X          6070    5       -10.25
000046          MPC     7010    7010    2       1.0     6070    2       -1.0            7010Y
000047          +7010Y          6070    4       10.25   6070    6       6.0
000048          MPC     7010    7010    3       1.0     6070    3       -1.0            7010Z
000049          +7010Z          6070    5       -6.0
000050          MPC     7010    7010    4       1.0     6070    4       -1.0
000051          MPC     7010    7010    5       1.0     6070    5       -1.0
000052          MPC     7010    7010    6       1.0     6070    6       -1.0
000053          MPC     8300    6080    1       1.0     6050    1       -1.0            6080A
000054          +6080A          6050    5       -20.48  6050    6       -14.34
000055          MPC     8300    6130    1       1.0     6050    1       -1.0            6130A
000056          +6130A          6050    5       14.34   6050    6       -20.48
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000057  MPC     8300    8300    1       1.0     8170    1       -1.0
000058  MPC     8300    8400    1       1.0     8080    1       -1.0
000059  $*************************************************************************
000060  $
000061  $                       OMITTED COORDINATE SET
000062  $
000063  OMIT1   123456  2020    3010    3030    3040    4025    8000    8001    6DOFA
000064  +6DOFA  8002    8005    8010    8020    8021    8022    8160    8030    6DOFB
000065  +6DOFB  8110    8130    8140    4010
000066  OMIT1   456     2000    8170    2040    3000    8210    3020    8180    3DOFA
000067  +3DOFA  8190    4000    8150    4020    8200    4030    5000    6000    3DOFB
000068  +3DOFB  6020    6030    6040    6070    7020    7030    7040    8040    3DOFC
000069  +3DOFC  8050    8060    8070    8080    8090    8100    8120
000070  $*************************************************************************
000071  $
000072  $                           PARAM CARDS
000073  $
000074  PARAM   GRDPNT  0
000075  $*************************************************************************
000076  $
000077  $               GLOBAL AXES FOR PLOT ORIENTATION
000078  $
000079  GRID    1               430.                            123456
000080  GRID    2                       50.                     123456
000081  GRID    3                               50.             123456
000082  GRID    10              420.                            123456
000083  GRID    20                      40.                     123456
000084  GRID    30                              40.             123456
000085  PLOTEL  9001    10      1
000086  PLOTEL  9002    20      2
000087  PLOTEL  9003    30      3
000088  PLOTEL  9010    8120    8005            9011    8005    8025
000089  PLOTEL  9012    8025    8150            9013    8150    8140
000090  PLOTEL  9014    8140    8130            9015    8130    8120
000091  PLOTEL  9020    8200    8050            9021    8050    8040
000092  PLOTEL  9022    8040    8060            9023    8060    8110
000093  PLOTEL  9024    8110    8160            9025    8160    8200
000094  $*************************************************************************
000095  $
000096  $       C O N C E N T R A T E D   M A S S   I T E M S
000097  $
000098  $                       P   F   S
000099  CONM2   9001    2050    2       0.15    28.82   17.6    -2.09
000100  CONM2   9002    5010            .037    -3.36   12.4    7.12
000101  CONM2   9003    5010            1.19    -2.82   .0      .0
000102  CONM2   9004    6060            0.98    2.42    -26.1   .0
000103  CONM2   9005    6050            .86     -1.5    26.5    14.5
000104  CONM2   9006    6050            0.92    4.50    27.5    0.0
000105  $               DESTRUCT SUBSYSTEM
000106  $
000107  $               NOZZLE TO EXTENSION ATTACHMENT
000108  CONM2   2051    2050            .0855                           NEA
000109  +NEA    72.             36.                     36.
000110  $               CORE SUPPORT
000111  CONM2   3051    3050            0.668   -4.93                   CS
000112  +CS     328.            170.                    170.
000113  $               FLANGE
000114  CONM2   3052    3050            1.08    2.07                    FLANGE
000115  +FLANGE 594.            298.                    298.
000116  $               AFT RING
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000117  CONM2   2052    2050            0.40                                    RING
000118  +RING   335.            168.                    168.
000119  $               TORUS
000120  CONM2   2053    2050            0.198   -3.11                           TORUS
000121  +TORUS  181.            91.                     91.
000122  $               NOZZLE TO PV BOLTS
000123  CONM2   3057    3050            .096    1.07                            BOLTS
000124  +BOLTS  51.15           25.65                   25.65
000125  $               CONTROL DRUM ACTUATORS (18)
000126  CONM2   5011    5010    8000    .0344   24.5    10.
000127  CONM2   5012    5010    8000    .0344   24.5    30.
000128  CONM2   5013    5010    8000    .0344   24.5    50.
000129  CONM2   5014    5010    8000    .0344   24.5    70.
000130  CONM2   5015    5010    8000    .0344   24.50   90.
000131  CONM2   5016    5010    8000    .0344   24.50   110.
000132  CONM2   5017    5010    8000    .0344   24.50   130.
000133  CONM2   5018    5010    8000    .0344   24.50   150.
000134  CONM2   5019    5010    8000    .0344   24.50   170.
000135  CONM2   50110   5010    8000    .0344   24.50   190.
000136  CONM2   50111   5010    8000    .0344   24.50   210.
000137  CONM2   50112   5010    8000    .0344   24.50   230.
000138  CONM2   50113   5010    8000    .0344   24.50   250.
000139  CONM2   50114   5010    8000    .0344   24.50   270.
000140  CONM2   50115   5010    8000    .0344   24.50   290.
000141  CONM2   50116   5010    8000    .0344   24.50   310.
000142  CONM2   50117   5010    8000    .0344   24.50   330.
000143  CONM2   50118   5010    8000    .0344   24.50   350.
000144  $               SHIELD
000145  CONM2   6010    6010            25.06   1.67                            SHIELD
000146  +SHIELD 29743.          14957.                  14957.
000147  $               NOZICE
000148  CONM2   6021    6020            1.55
000149  $                       ACTUATORS
000150  CONM2   60801   6080            0.24
000151  CONM2   61301   6130            0.24
000152  CONM2   83001   8300            0.24
000153  CONM2   84001   8400            0.24
000154  $                       SIMPLE NSS
000155  CONM2   4001    4001            29.
000156  CONM2   4002    4002            6.02
000157  CONM2   4003    4003            2.90
000158  $*****************************************************************************
000159  $
000160  $       COMPONENT NO. 2         NOZZLE EXTENSION
000161  $
000162  CBAR    2020    2020    2020    2000
000163  CBAR    2040    2040    2040    2020
000164  CBAR    2050    2050    2050    2040
000165  GRID    2000            409.372
000166  GRID    2020            351.543
000167  GRID    2040            296.865
000168  GRID    2050            270.190
000169  MAT1    100     1.7E6   0.70E6          1.355E-4
000170  PBAR    2020    100     40.865  55550.  55550.  111100. .00445
000171  PBAR    2040    100     33.253  30250.  30250.  60500.  .00445
000172  PBAR    2050    100     50.047  25400.  25400.  50800.  .00445
000173  $*****************************************************************************
000174  $
000175  $       COMPONENT NO. 3         NOZZLE
000176  $
```

```
000177          CBAR    3000    3000    3000    2050
000178          CBAR    3010    3010    3010    3000
000179          CBAR    3020    3020    3020    3010
000180          CBAR    3030    3030    3030    3020
000181          CBAR    3040    3040    3040    3030
000182          CBAR    3050    3050    3050    3040
000183          GRID    3000            254.218
000184          GRID    3010            233.25
000185          GRID    3020            225.90
000186          GRID    3030            220.491
000187          GRID    3040            213.236
000188          GRID    3050            206.93
000189          MAT1    347     29.3E6  11.4E6          7.394E-4
000190          PBAR    3000    347     11.5    3414.   3414.   6828.   .007
000191          PBAR    3010    347     32.3    4371.   4371.   8742.   .007
000192          PBAR    3020    347     16.3    567.    567.    1133.   .007
000193          PBAR    3030    347     13.7    333.    333.    666.    .007
000194          PBAR    3040    347     25.2    2070.   2070.   4140.   .007
000195          PBAR    3050    347     82.2    16170.  16170.  32340.  .007
000196          $*************************************************************************
000197          $
000198          $       NUCLEAR SUBSYSTEM       SIMPLE MODEL
000199          $
000200          CELAS2  40011   41.8E6  4001    1       3050    1
000201          CELAS2  40012   9.41E6  4001    2       3050    2
000202          CELAS2  40013   9.41E6  4001    3       3050    3
000203          CELAS2  40021   334.E6  4002    1       4001    1
000204          CELAS2  40022   61.7E6  4002    2       4001    2
000205          CELAS2  40023   61.7E6  4002    3       4001    3
000206          CELAS2  40031   0.48E6  4003    1       4002    1
000207          CELAS2  40032   16.5E6  4003    2       4002    2
000208          CELAS2  40033   16.5E6  4003    3       4002    3
000209          GRID    4001            170.0                           456
000210          GRID    4002            129.0                           456
000211          GRID    4003            124.0                           456
000212          $*************************************************************************
000213          $
000214          $       COMPONENT NO. 4       PRESSURE VESSEL
000215          $
000216          CBAR    4000    4000    4000    3050
000217          CBAR    4010    4000    4010    4000
000218          CBAR    4020    4000    4020    4010
000219          CBAR    4025    4000    4025    4020
000220          CBAR    4030    4000    4030    4025
000221          GRID    4000            185.5175
000222          GRID    4010            164.105
000223          GRID    4020            142.6925
000224          GRID    4025            124.67
000225          GRID    4030            121.28
000226          MAT1    7075    10.3E6  3.9E6           2.616E-4
000227          PBAR    4000    7075    139.933 51600.  51600.  103200. .0114
000228          $*************************************************************************
000229          $
000230          $       COMPONENT NO. 5       PRESSURE VESSEL CLOSURE
000231          $
000232          CBAR    5000    5000    5000    4030
000233          CBAR    5010    5010    5010    5000
000234          GRID    5000            115.97
000235          GRID    5010            110.28
000236          PBAR    5000    7075    233.1   81850.  81850.  163700. .0545
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000237  PBAR    5010    7075    290.28  64000.  64000.  12800.  .0545
000238  $*************************************************************************
000239  $
000240  $       CONPONENT NO.6          LOWER THRUST STRUCTURE
000241  $
000242  CBAR    6000    6000    6000    5010
000243  CBAR    6010    6000    6010    6000
000244  CBAR    6020    6000    6020    6010
000245  CBAR    6030    6000    6030    6020
000246  CBAR    6040    6040    6040    6030
000247  CBAR    6050    6050    6050    6040
000248  CBAR    6060    6060    6060    6050
000249  CBAR    6070    6070    6070    6060
000250  GRID    6000            98.0
000251  GRID    6010            86.33
000252  GRID    6020            74.50
000253  GRID    6030            68.58
000254  GRID    6040            57.0
000255  GRID    6050            39.5
000256  GRID    6060            32.38
000257  GRID    6070            29.0
000258  GRID    6080    8000    25.0    125.0   39.50           23456
000259  GRID    6130    8000    25.0    215.0   39.50           23456
000260  MAT1    7039    10.1E6  3.78E6          2.56E-4
000261  PBAR    6000    7039    11.94   2155.   2155.   4310.   .0282
000262  PBAR    6040    7039    11.64   1989.   1989.   3978.   .0282
000263  PBAR    6050    7039    10.681  1543.   1543.   3087.   .0282
000264  PBAR    6060    7039    9.90    1228.   1228.   2456.   .0282
000265  PBAR    6070    7039    9.58    1114.   1114.   2228.   .0282
000266  $*************************************************************************
000267  $
000268  $       COMPONENT NO. 7         GIMBAL
000269  $
000270  CBAR    7031    7031    7030    7000    0.0     10.0    -10.0   1       7031
000271  +7031           4
000272  CBAR    7032    7031    7030    7040    0.0     10.0    10.0    1       7032
000273  +7032           4
000274  CBAR    7033    7031    7030    7010    0.0     -10.0   10.0    1       7033
000275  +7033           4
000276  CBAR    7034    7031    7030    7020    0.0     -10.0   -10.0   1       7034
000277  +7034           4
000278  CONROD  7021    7020    8001    250     2.0
000279  CONROD  7022    7020    8010    250     2.0
000280  CONROD  7023    7020    8002    250     2.0
000281  CONROD  7024    7020    8000    250     2.0
000282  CONROD  7041    7040    8030    250     2.0
000283  CONROD  7042    7040    8021    250     2.0
000284  CONROD  7043    7040    8022    250     2.0
000285  CONROD  7044    7040    8020    250     2.0
000286  CTRIA2  7121    8012    8000    8005    7020
000287  CTRIA2  7122    8012    8001    8005    7020
000288  CTRIA2  7123    8012    8002    8005    7020
000289  CTRIA2  7124    8012    8010    8005    7020
000290  CTRIA2  7125    8012    8001    8000    7020
000291  CTRIA2  7126    8012    8000    8002    7020
000292  CTRIA2  7127    8012    8002    8010    7020
000293  CTRIA2  7128    8012    8010    8001    7020
000294  CTRIA2  7141    8012    8020    8025    7040
000295  CTRIA2  7142    8012    8021    8025    7040
000296  CTRIA2  7143    8012    8022    8025    7040
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000297 CTRIA2  7144    8012    8030    8025    7040
000298 CTRIA2  7145    8012    8021    8020    7040
000299 CTRIA2  7146    8012    8020    8022    7040
000300 CTRIA2  7147    8012    8022    8030    7040
000301 CTRIA2  7148    8012    8030    8021    7040
000302 GRID    7000            23.0    0.0     -10.25
000303 GRID    7010            23.0    0.0     10.25
000304 GRID    7020            23.0    -10.25  0.0
000305 GRID    7030            23.0    0.0     0.0
000306 GRID    7040            23.0    10.25   0.0
000307 MAT1    250     24.0E6  9.24E6          7.33E-4
000308 PBAR    7031    250     3.0     10.0    10.0    20.0
000309 $*************************************************************************
000310 $
000311 $       COMPONENT NO. 8         UPPER THRUST STRUCTURE
000312 $
000313 CBAR    8000    8000    8090    8000    8160    0       0       2
000314 CBAR    8001    8000    8001    8040    8110    0       0       2
000315 CBAR    8002    8000    8170    8002    8110    0       0       2
000316 CBAR    8010    8000    8010    8050    8160    0       0       2
000317 CBAR    8021    8000    3021    8100    8140    0       0       2
000318 CBAR    8022    8000    8050    8022    8140    0       0       2
000319 CBAR    8030    8000    8030    8180    8140    0       0       2
000320 CBAR    8040    8000    8040    8020    8140    0       0       2
000321 CBAR    8050    8000    8050    8210    8160    0       0       2
000322 CBAR    8052    8000    8190    8050    8140    0       0       2
000323 CBAR    8061    8170    8060    8080    -10.0   -10.    0.0     1       8061
000324 +8061                   -3.4                    -3.4
000325 CBAR    8065    8190    8060    8080    -10.0   -10.0   0.0     1       8065
000326 +8065                   -2.5                    -2.5
000327 CBAR    8072    8000    8040    8070    8110    0       0       2
000328 CBAR    8073    8170    8070    8060    -10.0   -10.    0.0     1       8073
000329 +8073                   -3.4                    -3.4
000330 CBAR    8075    8190    8070    8060    -10.0   -10.0   0.0     1       8075
000331 +8075                   -2.5                    -2.5
000332 CBAR    8081    8000    8080    8040    8140    0       0       2
000333 CBAR    8085    8190    8080    8090    -10.0   -10.0   -10.0   1       8085
000334 +8085                   -2.5                    -2.5
000335 CBAR    8095    8190    8090    8120    -10.0   -3.75   -14.0   1       8095
000336 +8095                   -2.5                    -2.5
000337 CBAR    8105    8190    8100    8070    -10.0   -10.    10.     1       8105
000338 +8105                   -2.5                    -2.5
000339 CBAR    8125    8190    8120    8170    -10.0   3.75    -14.0   1       8125
000340 +8125                   -2.5                    -2.5
000341 CBAR    8155    8190    8150    8100    -10.0   -3.75   14.0    1       8155
000342 +8155                   -2.5                    -2.5
000343 CBAR    8171    8170    8170    8090    -10.0   0.0     10.0    1       8171
000344 +8171                   -3.4                    -3.4
000345 CBAR    8175    8190    8170    8190    -10.0   10.0    -10.0   1       8175
000346 +8175                   -2.5                    -2.5
000347 CBAR    8181    8170    8180    8100    -10.0   0.0     10.0    1       8181
000348 +8181                   -3.4                    -3.4
000349 CBAR    8185    8190    8180    8150    -10.0   3.75    14.0    1       8185
000350 +8185                   -2.5                    -2.5
000351 CBAR    8191    8170    8190    8200    -10.    10.     0.      1       8191
000352 +8191                   -3.4                    -3.4
000353 CBAR    8195    8190    8190    8200    -10.0   10.0    0.0     1       8195
000354 +8195                   -2.5                    -2.5
000355 CBAR    8201    8170    8200    8210    -10.    10.     0.      1       8201
000356 +8201                   -3.4                    -3.4
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000357  CBAR    8205    8190    8200    8210    -10.0   10.0    0.0     1       8205
000358  +8205                   -2.5                    -2.5
000359  CBAR    8215    8190    8210    8180    -10.0   10.     10.     1       8215
000360  +8215                   -2.5                    -2.5
000361  CQDMEM  8006    8006    8040    8110    8130    8001
000362  CQDMEM  8011    8006    8050    8160    8130    8010
000363  CQDMEM  8043    8006    8040    8110    8140    8020
000364  CQDMEM  8192    8006    8050    8160    8140    8022
000365  CROD    8041    8041    8040    8110    8051    8041    8050    8160
000366  CROD    8071    8130    8110    8070    8161    8130    8190    8160
000367  CROD    8111    8130    8110    8140    8140    8130    8140    8180
000368  CROD    8130    8130    8090    8130    8160    8130    8130    8160
000369  CROD    8162    8130    8160    8140    8163    8130    8140    8100
000370  CROD    8171    8130    8170    8130    8131    8130    8130    8110
000371  CROD    8210    8130    8160    8210    8110    8130    8080    8110
000372  CTRIA2  8001    8001    8000    8130    8090
000373  CTRIA2  8002    8002    8005    8130    8000
000374  CTRIA2  8003    8002    8005    8130    8010
000375  CTRIA2  8004    8001    8002    8130    8170
000376  CTRIA2  8005    8002    8005    8130    8002
000377  CTRIA2  8007    8001    8040    8110    8070
000378  CTRIA2  8008    8002    8005    8130    8001
000379  CTRIA2  8012    8012    8000    8001    8005
000380  CTRIA2  8013    8012    8001    8010    8005
000381  CTRIA2  8014    8012    8010    8002    8005
000382  CTRIA2  8015    8012    8002    8000    8005
000383  CTRIA2  8026    8002    8025    8140    8020
000384  CTRIA2  8027    8002    8025    8140    8030
000385  CTRIA2  8031    8001    8030    8140    8180
000386  CTRIA2  8032    8012    8021    8030    8025
000387  CTRIA2  8033    8012    8030    8022    8025
000388  CTRIA2  8034    8012    8022    8020    8025
000389  CTRIA2  8036    8012    8020    8021    8025
000390  CTRIA2  8052    8001    8050    8160    8210
000391  CTRIA2  8082    8001    8040    8110    8080
000392  CTRIA2  8121    8001    8090    8120    8170
000393  CTRIA2  8151    8001    8100    8150    8180
000394  CTRIA2  8191    8001    8050    8160    8190
000395  CTRIA2  8193    8002    8025    8140    8022
000396  CTRIA2  8194    8002    8025    8140    8021
000397  CTRIA2  8195    8001    8021    8140    8100
000398  GRID    8000            17.0    -13.25  3.0
000399  GRID    8001            17.0    -7.25   3.0
000400  GRID    8002            17.0    -13.25  -3.0
000401  GRID    8005            17.0    -10.25  0.0
000402  GRID    8010            17.0    -7.25   -3.0
000403  GRID    8020            17.0    7.25    3.0
000404  GRID    8021            17.0    13.25   3.0
000405  GRID    8022            17.0    7.25    -3.0
000406  GRID    8025            17.0    10.25   0.0
000407  GRID    8030            17.0    13.25   -3.0
000408  GRID    8040            17.0    0.0     10.25
000409  GRID    8050            17.0    0.0     -10.25
000410  GRID    8060            0.0     0.0     24.25
000411  GRID    8070    8000    28.0    60.     0.0
000412  GRID    8080    8000    28.0    120.    0.0
000413  GRID    8090    8000    28.0    150.    0.0
000414  GRID    8100    8000    28.0    30.     0.0
000415  GRID    8110            0.0     0.0     10.25
000416  GRID    8120    8000    28.0    180.    .0
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000417 GRID    8130          0.0     -10.25    .0
000418 GRID    8140          0.0     10.25     .0
000419 GRID    8150    8000  28.0    .0        .0
000420 GRID    8160          0.0     .0        -10.25
000421 GRID    8170    8000  28.0    -150.     .0
000422 GRID    8180    8000  28.0    -30.      .0
000423 GRID    8190    8000  28.0    -120.     .0
000424 GRID    8200          0.0     .0        -24.25
000425 GRID    8210    8000  28.0    -60.      .0
000426 GRID    8300    8000  25.0    215.0     0.0     0       23456
000427 GRID    8400    8000  25.0    125.0     0.0     0       23456
000428 MAT1    2024    10.5E6 4.0E6            2.6E-4
000429 PBAR    8000    2024  1.17    .08       .26
000430 PBAR    8170    2024  0.50    4.3       .0002
000431 PBAR    8190    2024  .8      2.36      2.36    3.55
000432 PODMEM  8006    2024  0.10
000433 PROD    8041    2024  0.35
000434 PROD    8130    2024  0.435
000435 PTRIA2  8001    2024  0.064
000436 PTRIA2  8002    2024  0.20
000437 PTRIA2  8012    2024  .125
000438 $*************************************************************************
000439 $
000440 $                              M I N I - T A N K
000441 $
000442 $                              LOWER (AFT) TRUSS
000443 CROD    85001   8500  8500    8080    85002   8500    8500    8070
000444 CROD    85011   8500  8501    8090    85012   8500    8501    8060
000445 CROD    85021   8500  8502    8060    85022   8500    8502    8100
000446 CROD    85031   8500  8503    8120    85032   8500    8503    8080
000447 CROD    85041   8500  8504    8070    85042   8500    8504    8150
000448 CROD    85051   8500  8505    8170    85052   8500    8505    8090
000449 CROD    85061   8500  8506    8100    85062   8500    8506    8180
000450 CROD    85071   8500  8507    8190    85072   8500    8507    8120
000451 CROD    85081   8500  8508    8150    85082   8500    8508    8210
000452 CROD    85091   8500  8509    8200    85092   8500    8509    8170
000453 CROD    85101   8500  8510    8180    85102   8500    8510    8200
000454 CROD    85111   8500  8511    8210    85112   8500    8511    8190
000455 GRID    8500    8000  68.9330390.     -69.39698000    456
000456 GRID    8501    8000  68.93303120.    -69.39698000    456
000457 GRID    8502    8000  68.9330360.     -69.39698000    456
000458 GRID    8503    8000  68.93303150.    -69.39698000    456
000459 GRID    8504    8000  68.9330330.     -69.39698000    456
000460 GRID    8505    8000  68.93303180.    -69.39698000    456
000461 GRID    8506    8000  68.93303.0      -69.39698000    456
000462 GRID    8507    8000  68.93303-150.   -69.39698000    456
000463 GRID    8508    8000  68.93303-30.    -69.39698000    456
000464 GRID    8509    8000  68.93303-120.   -69.39698000    456
000465 GRID    8510    8000  68.93303-60.    -69.39698000    456
000466 GRID    8511    8000  68.93303-90.    -69.39698000    456
000467 PROD    8500    8500  0.767
000468 $                              UPPER (FORWARD) TRUSS
000469 CROD    86001   8600  8600    8701    86002   8600    8600    8702
000470 CROD    86011   8600  8601    8703    86012   8600    8601    8700
000471 CROD    86021   8600  8602    8700    86022   8600    8602    8704
000472 CROD    86031   8600  8603    8705    86032   8600    8603    8701
000473 CROD    86041   8600  8604    8702    86042   8600    8604    8706
000474 CROD    86051   8600  8605    8707    86052   8600    8605    8703
000475 CROD    86061   8600  8606    8704    86062   8600    8606    8708
000476 CROD    86071   8600  8607    8709    86072   8600    8607    8705
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000477          CROD    86081   8600    8608    8706    86082   8600    8608    8710
000478          CROD    86091   8600    8609    8711    86092   8600    8609    8707
000479          CROD    86101   8600    8610    8708    86102   8600    8610    8711
000480          CROD    86111   8600    8611    8710    86112   8600    8611    8709
000481          GRID    8600    8000    80.0    90.     -219.0  8000    456
000482          GRID    8601    8000    80.0    120.    -219.0  8000    456
000483          GRID    8602    8000    80.0    60.     -219.0  8000    456
000484          GRID    8603    8000    80.     150.    -219.0  8000    456
000485          GRID    8604    8000    80.     30.     -219.0  8000    456
000486          GRID    8605    8000    80.     180.    -219.0  8000    456
000487          GRID    8606    8000    80.     .0      -219.0  8000    456
000488          GRID    8607    8000    80.     -150.   -219.0  8000    456
000489          GRID    8608    8000    80.     -30.    -219.0  8000    456
000490          GRID    8609    8000    80.     -120.   -219.0  8000    456
000491          GRID    8610    8000    80.     -60.    -219.0  8000    456
000492          GRID    8611    8000    80.     -90.    -219.0  8000    456
000493          GRID    8700    8000    85.0    90.     -320.           456
000494          GRID    8701    8000    85.0    120.    -320.           456
000495          GRID    8702    8000    85.0    60.     -320.           456
000496          GRID    8703    8000    85.0    150.    -320.           456
000497          GRID    8704    8000    85.0    30.     -320.           456
000498          GRID    8705    8000    85.0    180.    -320.           456
000499          GRID    8706    8000    85.0    .0      -320.           456
000500          GRID    8707    8000    85.0    -150.   -320.           456
000501          GRID    8708    8000    85.0    -30.    -320.           456
000502          GRID    8709    8000    85.0    -120.   -320.           456
000503          GRID    8710    8000    85.0    -60.    -320.           456
000504          GRID    8711    8000    85.0    -90.    -320.           456
000505          PROD    8600    8500    0.860
000506          MAT1    8500    5.75E6          0.3     1.75E-4
000507          $         ALL CARGO BAY INTERFACE POINTS ARE TO REMAIN IN THE SAME PLANE
000508          MPC     8700    8701    1       1.0     8700    1       -1.0
000509          MPC     8700    8702    1       1.0     8700    1       -1.0
000510          MPC     8700    8703    1       1.0     8700    1       -1.0
000511          MPC     8700    8704    1       1.0     8700    1       -1.0
000512          MPC     8700    8705    1       1.0     8700    1       -1.0
000513          MPC     8700    8706    1       1.0     8700    1       -1.0
000514          MPC     8700    8707    1       1.0     8700    1       -1.0
000515          MPC     8700    8708    1       1.0     8700    1       -1.0
000516          MPC     8700    8709    1       1.0     8700    1       -1.0
000517          MPC     8700    8710    1       1.0     8700    1       -1.0
000518          MPC     8700    8711    1       1.0     8700    1       -1.0
000519          MPC     8700    8701    2       1.0     8700    2       -1.0
000520          MPC     8700    8702    2       1.0     8700    2       -1.0
000521          MPC     8700    8703    2       1.0     8700    2       -1.0
000522          MPC     8700    8704    2       1.0     8700    2       -1.0
000523          MPC     8700    8705    2       1.0     8700    2       -1.0
000524          MPC     8700    8706    2       1.0     8700    2       -1.0
000525          MPC     8700    8707    2       1.0     8700    2       -1.0
000526          MPC     8700    8708    2       1.0     8700    2       -1.0
000527          MPC     8700    8709    2       1.0     8700    2       -1.0
000528          MPC     8700    8710    2       1.0     8700    2       -1.0
000529          MPC     8700    8711    2       1.0     8700    2       -1.0
000530          MPC     8700    8701    3       1.0     8700    3       -1.0
000531          MPC     8700    8702    3       1.0     8700    3       -1.0
000532          MPC     8700    8703    3       1.0     8700    3       -1.0
000533          MPC     8700    8704    3       1.0     8700    3       -1.0
000534          MPC     8700    8705    3       1.0     8700    3       -1.0
000535          MPC     8700    8706    3       1.0     8700    3       -1.0
000536          MPC     8700    8707    3       1.0     8700    3       -1.0
```

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000537          MPC     8700    8708    3       1.0     8700    3       -1.0
000538          MPC     8700    8709    3       1.0     8700    3       -1.0
000539          MPC     8700    8710    3       1.0     8700    3       -1.0
000540          MPC     8700    8711    3       1.0     8700    3       -1.0
000541          $               MODAL COORDINATE DATA
000542          SPOINT  101     THRU    109
000543          CMASS4  101     2.927   101
000544          CMASS4  102     2.927   102
000545          CMASS4  103     0.664   103
000546          CMASS4  104     1.311   104
000547          CMASS4  105     0.444   105
000548          CMASS4  106     0.2018  106
000549          CMASS4  107     0.1584  107
000550          CMASS4  108     0.1940  108
000551          CMASS4  109     0.2043  109
000552          CELAS4  204     1.251E6 104
000553          CELAS4  205     1.262E6 105
000554          CELAS4  206     7.457E5 106
000555          CELAS4  207     6.729E5 107
000556          CELAS4  208     8.818E5 108
000557          CELAS4  209     9.914E5 109
000558          $           THESE ARE THE MPC'S FOR THE MODAL CONSTRAINTS
000559          $               MODAL CONSTRAINT EQUATIONS
000560          $*************************************************************************
000561          $
000562          $                       GIMBAL  ACTUATORS
000563          $
000564          CELAS2  8301    1.15E6  6130    1       8300    1
000565          CELAS2  8401    1.15E6  6080    1       8400    1
000566          $*************************************************************************
000567          $
000568          $               T P A   STRUCTURE USED FOR ALL MINI-TANK RUNS
000569          $
000570          $               T P A   # 1
000571          GRID    6061    8000    35.0    -90.    43.             456
000572          CONM2   9007    6061            1.97
000573          CELAS2  60611   2.0E+6  6061    1       6070    1
000574          CELAS2  606121  2.0E+6  6061    2       6070    2
000575          CELAS2  606122  1.4E+6  6061    2       6040    2
000576          CELAS2  606131  2.0E+6  6061    3       6070    3
000577          CELAS2  606132  1.4E+6  6061    3       6040    3
000578          $
000579          $               T P A   # 2
000580          GRID    6062    8000    35.0     90.    43.             456
000581          CONM2   9008    6062            1.97
000582          CELAS2  60621   2.0E+6  6062    1       6070    1
000583          CELAS2  606221  2.0E+6  6062    2       6070    2
000584          CELAS2  606222  1.4E+6  6062    2       6040    2
000585          CELAS2  606231  2.0E+6  6062    3       6070    3
000586          CELAS2  606232  1.4E+6  6062    3       6040    3
000587          $*************************************************************************
000588          $
000589          $                       EOS SUPPORT FRAME
000590          $                        SUPPORT FRAME DELETED
000591          $
000592          $*************************************************************************
```

APPENDIX A

CASE 8

53

@ ELT NSO/CASE8,1,720112, 36744

```
000001  BAROR                                   1000.0  1000.0  0.0     1
000002  $*************************************************************************
000003  $
000004  $                       COORDINATE SYSTEM DEFINITIONS
000005  $
000006  CORD2C  2               256.1   .0      .0      300.    .0      .0      BC
000007  +BC     300.0   -50.0   0.0
000008  CORD2C  8000            0.0     0.0     0.0     1000.0  0.0     0.0     CYL
000009  +CYL    1000.0  1000.0  0.0
000010  $*************************************************************************
000011  $
000012  $         SUPORT CARD FOR RIGID BODY MODES
000013  $
000014  $*************************************************************************
000015  $
000016  $                       EIGENVALUE EXTRACTION
000017  $
000018  EIGR    25      GIV                             25              1.E-6   GIV25
000019  +GIV25  MAX
000020  $*************************************************************************
000021  $
000022  $                       SINGLE-POINT CONSTRAINT SETS
000023  $
000024  SPC1    10      123456  8700
000025  $*************************************************************************
000026  $
000027  $                               MULTI-POINT CONSTRAINTS
000028  $
000029  MPCADD  10      6062    7000    7010    8300    8500    8700                    *NEW
000030  $                                                                               *NEW
000031  $           MPC TPA #2 TO TPA #1                                                *NEW
000032  MPC     6062    6062    1       1.0     6061    1       -1.0                    *NEW
000033  MPC     6062    6062    2       1.0     6061    2       -1.0                    *NEW
000034  MPC     6062    6062    3       1.0     6061    3       -1.0                    *NEW
000035  MPC     7000    7000    1       1.0     6070    1       -1.0            7000X   **-1
000036  +7000X          6070    5       10.25
000037  MPC     7000    7000    2       1.0     6070    2       -1.0            7000Y
000038  +7000Y          6070    4       -10.25  6070    6       6.0
000039  MPC     7000    7000    3       1.0     6070    3       -1.0            7000Z
000040  +7000Z          6070    5       -6.0
000041  MPC     7000    7000    4       1.0     6070    4       -1.0
000042  MPC     7000    7000    5       1.0     6070    5       -1.0
000043  MPC     7000    7000    6       1.0     6070    6       -1.0
000044  MPC     7010    7010    1       1.0     6070    1       -1.0            7010X
000045  +7010X          6070    5       -10.25
000046  MPC     7010    7010    2       1.0     6070    2       -1.0            7010Y
000047  +7010Y          6070    4       10.25   6070    6       6.0
000048  MPC     7010    7010    3       1.0     6070    3       -1.0            7010Z
000049  +7010Z          6070    5       -6.0
000050  MPC     7010    7010    4       1.0     6070    4       -1.0
000051  MPC     7010    7010    5       1.0     6070    5       -1.0
000052  MPC     7010    7010    6       1.0     6070    6       -1.0
000053  MPC     8300    6080    1       1.0     6050    1       -1.0            6080A
000054  +6080A          6050    5       -20.48  6050    6       -14.34
000055  MPC     8300    6130    1       1.0     6050    1       -1.0            6130A
000056  +6130A          6050    5       14.34   6050    6       -20.48
```

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000057  MPC     8300    8300    1       1.0     8170    1       -1.0
000058  MPC     8300    8400    1       1.0     8080    1       -1.0
000059  $*************************************************************************
000060  $
000061  $                       OMITTED COORDINATE SET
000062  $
000063  OMIT1   123456  2020    3010    3030    3040    4025    8000    8001    6DOFA
000064  +6DOFA  8002    8005    8010    8020    8021    8022    8160    8030    6DOFB
000065  +6DOFB  8110    8130    8140    4010
000066  OMIT1   456     2000    8170    2040    3000    8210    3020    8180    3DOFA
000067  +3DOFA  8190    4000    8150    4020    8200    4030    5000    6000    3DOFB
000068  +3DOFB  6020    6030    6040    6070    7020    7030    7040    8040    3DOFC
000069  +3DOFC  8050    8060    8070    8080    8090    8100    8120
000070  $*************************************************************************
000071  $
000072  $                           PARAM CARDS
000073  $
000074  PARAM   GRDPNT  0
000075  $*************************************************************************
000076  $
000077  $               GLOBAL AXES FOR PLOT ORIENTATION
000078  $
000079  GRID    1               430.                            123456
000080  GRID    2                       50.                     123456
000081  GRID    3                               50.             123456
000082  GRID    10              420.                            123456
000083  GRID    20                      40.                     123456
000084  GRID    30                              40.             123456
000085  PLOTEL  9001    10      1
000086  PLOTEL  9002    20      2
000087  PLOTEL  9003    30      3
000088  PLOTEL  9010    8120    8005            9011    8005    8025
000089  PLOTEL  9012    8025    8150            9013    8150    8140
000090  PLOTEL  9014    8140    8130            9015    8130    8120
000091  PLOTEL  9020    8200    8050            9021    8050    8040
000092  PLOTEL  9022    8040    8060            9023    8060    8110
000093  PLOTEL  9024    8110    8160            9025    8160    8200
000094  $*************************************************************************
000095  $
000096  $       C O N C E N T R A T E D   M A S S   I T E M S
000097  $
000098  $                       P   F   S
000099  CONM2   9001    2050    2       0.15    28.82   17.6    -2.09
000100  CONM2   9002    5010            .037    -3.36   12.4    7.12
000101  CONM2   9003    5010            1.19    -2.82   .0      .0
000102  CONM2   9004    6060            0.98    2.42    -26.1   .0
000103  CONM2   9005    6050            .86     -1.5    26.5    14.5
000104  CONM2   9006    6050            0.92    4.50    27.5    0.0
000105  $               DESTRUCT SUBSYSTEM
000106  $
000107  $               NOZZLE TO EXTENSION ATTACHMENT
000108  CONM2   2051    2050            .0855                           NEA
000109  +NEA    72.             36.                     36.
000110  $               CORE SUPPORT
000111  CONM2   3051    3050            0.668   -4.93                   CS
000112  +CS     328.            170.                    170.
000113  $               FLANGE
000114  CONM2   3052    3050            1.08    2.07                    FLANGE
000115  +FLANGE 594.            298.                    298.
000116  $               AFT RING
```

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000117  CONM2   2052    2050            0.40                                    RING
000118  +RING   335.            168.                    168.
000119  $               TORUS
000120  CONM2   2053    2050            0.198   -3.11                           TORUS
000121  +TORUS  181.            91.                     91.
000122  $               NOZZLE TO PV BOLTS
000123  CONM2   3057    3050            .096    1.07                            BOLTS
000124  +BOLTS  51.15           25.65                   25.65
000125  $               CONTROL DRUM ACTUATORS (18)
000126  CONM2   5011    5010    8000    .0344   24.5    10.
000127  CONM2   5012    5010    8000    .0344   24.5    30.
000128  CONM2   5013    5010    8000    .0344   24.5    50.
000129  CONM2   5014    5010    8000    .0344   24.5    70.
000130  CONM2   5015    5010    8000    .0344   24.50   90.
000131  CONM2   5016    5010    8000    .0344   24.50   110.
000132  CONM2   5017    5010    8000    .0344   24.50   130.
000133  CONM2   5018    5010    8000    .0344   24.50   150.
000134  CONM2   5019    5010    8000    .0344   24.50   170.
000135  CONM2   50110   5010    8000    .0344   24.50   190.
000136  CONM2   50111   5010    8000    .0344   24.50   210.
000137  CONM2   50112   5010    8000    .0344   24.50   230.
000138  CONM2   50113   5010    8000    .0344   24.50   250.
000139  CONM2   50114   5010    8000    .0344   24.50   270.
000140  CONM2   50115   5010    8000    .0344   24.50   290.
000141  CONM2   50116   5010    8000    .0344   -24.50  310.
000142  CONM2   50117   5010    8000    .0344   24.50   330.
000143  CONM2   50118   5010    8000    .0344   24.50   350.
000144  $               SHIELD
000145  $                               S H I E L D   R E M O V E D
000146  OMIT1   456     6010
000147  $               NDICE
000148  CONM2   6021    6020            1.55
000149  $                               ACTUATORS
000150  CONM2   60801   6080            0.24
000151  CONM2   61301   6130            0.24
000152  CONM2   83001   8300            0.24
000153  CONM2   84001   8400            0.24
000154  $                               SIMPLE NSS
000155  CONM2   4001    4001            29.
000156  CONM2   4002    4002            6.02
000157  CONM2   4003    4003            2.90
000158  $*************************************************************************
000159  $
000160  $       COMPONENT NO. 2         NOZZLE EXTENSION
000161  $
000162  CBAR    2020    2020    2020    2000
000163  CBAR    2040    2040    2040    2020
000164  CBAR    2050    2050    2050    2040
000165  GRID    2000            409.372
000166  GRID    2020            351.543
000167  GRID    2040            296.865
000168  GRID    2050            270.190
000169  MAT1    100     1.7E6   0.70E6          1.355E-4
000170  PBAR    2020    100     40.865  55550.  55550.  111100. .00445
000171  PBAR    2040    100     33.253  30250.  30250.  60500.  .00445
000172  PBAR    2050    100     50.047  25400.  25400.  50800.  .00445
000173  $*************************************************************************
000174  $
000175  $       COMPONENT NO. 3         NOZZLE
000176  $
```

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000177          CBAR    3000    3000    3000    2050
000178          CBAR    3010    3010    3010    3000
000179          CBAR    3020    3020    3020    3010
000180          CBAR    3030    3030    3030    3020
000181          CBAR    3040    3040    3040    3030
000182          CBAR    3050    3050    3050    3040
000183          GRID    3000            254.218
000184          GRID    3010            233.25
000185          GRID    3020            225.90
000186          GRID    3030            220.491
000187          GRID    3040            213.236
000188          GRID    3050            206.93
000189          MAT1    347     29.3E6  11.4E6          7.394E-4
000190          PBAR    3000    347     11.5    3414.   3414.   6828.   .007
000191          PBAR    3010    347     32.3    4371.   4371.   8742.   .007
000192          PBAR    3020    347     16.3    567.    567.    1133.   .007
000193          PBAR    3030    347     13.7    333.    333.    666.    .007
000194          PBAR    3040    347     25.2    2070.   2070.   4140.   .007
000195          PBAR    3050    347     82.2    16170.  16170.  32340.  .007
000196          $*************************************************************
000197          $
000198          $       NUCLEAR SUBSYSTEM       SIMPLE MODEL
000199          $
000200          CELAS2  40011   41.8E6  4001    1       3050    1
000201          CELAS2  40012   9.41E6  4001    2       3050    2
000202          CELAS2  40013   9.41E6  4001    3       3050    3
000203          CELAS2  40021   334.E6  4002    1       4001    1
000204          CELAS2  40022   61.7E6  4002    2       4001    2
000205          CELAS2  40023   61.7E6  4002    3       4001    3
000206          CELAS2  40031   0.48E6  4003    1       4002    1
000207          CELAS2  40032   16.5E6  4003    2       4002    2
000208          CELAS2  40033   16.5E6  4003    3       4002    3
000209          GRID    4001            170.0                           456
000210          GRID    4002            129.0                           456
000211          GRID    4003            124.0                           456
000212          $*************************************************************
000213          $
000214          $       COMPONENT NO. 4       PRESSURE VESSEL
000215          $
000216          CBAR    4000    4000    4000    3050
000217          CBAR    4010    4000    4010    4000
000218          CBAR    4020    4000    4020    4010
000219          CBAR    4025    4000    4025    4020
000220          CBAR    4030    4000    4030    4025
000221          GRID    4000            185.5175
000222          GRID    4010            164.105
000223          GRID    4020            142.6925
000224          GRID    4025            124.67
000225          GRID    4030            121.28
000226          MAT1    7075    10.3E6  3.9E6           2.616E-4
000227          PBAR    4000    7075    139.933 51600.  51600.  103200. .0114
000228          $*************************************************************
000229          $
000230          $       COMPONENT NO. 5       PRESSURE VESSEL CLOSURE
000231          $
000232          CBAR    5000    5000    5000    4030
000233          CBAR    5010    5010    5010    5000
000234          GRID    5000            115.97
000235          GRID    5010            110.28
000236          PBAR    5000    7075    233.1   81850.  81850.  163700. .0545
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000237  PBAR    5010    7075    290.28  64000.  64000.  12800.  .0545
000238  $*************************************************************************
000239  $
000240  $       CONPONENT NO.6          LOWER THRUST STRUCTURE
000241  $
000242  CBAR    6000    6000    6000    5010
000243  CBAR    6010    6000    6010    6000
000244  CBAR    6020    6000    6020    6010
000245  CBAR    6030    6000    6030    6020
000246  CBAR    6040    6040    6040    6030
000247  CBAR    6050    6050    6050    6040
000248  CBAR    6060    6060    6060    6050
000249  CBAR    6070    6070    6070    6060
000250  GRID    6000            98.0
000251  GRID    6010            86.33
000252  GRID    6020            74.50
000253  GRID    6030            68.58
000254  GRID    6040            57.0
000255  GRID    6050            39.5
000256  GRID    6060            32.38
000257  GRID    6070            29.0
000258  GRID    6080    8000    25.0    125.0   39.50           23456
000259  GRID    6130    8000    25.0    215.0   39.50           23456
000260  MAT1    7039    10.1E6  3.78E6          2.56E-4
000261  PBAR    6000    7039    11.94   2155.   2155.   4310.   .0282
000262  PBAR    6040    7039    11.64   1989.   1989.   3978.   .0282
000263  PBAR    6050    7039    10.681  1543.   1543.   3087.   .0282
000264  PBAR    6060    7039    9.90    1228.   1228.   2456.   .0282
000265  PBAR    6070    7039    9.58    1114.   1114.   2228.   .0282
000266  $*************************************************************************
000267  $
000268  $       COMPONENT NO. 7         GIMBAL
000269  $
000270  CBAR    7031    7031    7030    7000    0.0     10.0    -10.0   1       7031
000271  +7031           4
000272  CBAR    7032    7031    7030    7040    0.0     10.0    10.0    1       7032
000273  +7032           4
000274  CBAR    7033    7031    7030    7010    0.0     -10.0   10.0    1       7033
000275  +7033           4
000276  CBAR    7034    7031    7030    7020    0.0     -10.0   -10.0   1       7034
000277  +7034           4
000278  CONROD  7021    7020    8001    250     2.0
000279  CONROD  7022    7020    8010    250     2.0
000280  CONROD  7023    7020    8002    250     2.0
000281  CONROD  7024    7020    8000    250     2.0
000282  CONROD  7041    7040    8030    250     2.0
000283  CONROD  7042    7040    8021    250     2.0
000284  CONROD  7043    7040    8022    250     2.0
000285  CONROD  7044    7040    8020    250     2.0
000286  CTRIA2  7121    8012    8000    8005    7020
000287  CTRIA2  7122    8012    8001    8005    7020
000288  CTRIA2  7123    8012    8002    8005    7020
000289  CTRIA2  7124    8012    8010    8005    7020
000290  CTRIA2  7125    8012    8001    8000    7020
000291  CTRIA2  7126    8012    8000    8002    7020
000292  CTRIA2  7127    8012    8002    8010    7020
000293  CTRIA2  7128    8012    8010    8001    7020
000294  CTRIA2  7141    8012    8020    8025    7040
000295  CTRIA2  7142    8012    8021    8025    7040
000296  CTRIA2  7143    8012    8022    8025    7040
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000297          CTRIA2  7144    8012    8030    8025    7040
000298          CTRIA2  7145    8012    8021    8020    7040
000299          CTRIA2  7146    8012    8020    8022    7040
000300          CTRIA2  7147    8012    8022    8030    7040
000301          CTRIA2  7148    8012    8030    8021    7040
000302          GRID    7000            23.0    0.0     -10.25
000303          GRID    7010            23.0    0.0     10.25
000304          GRID    7020            23.0    -10.25  0.0
000305          GRID    7030            23.0    0.0     0.0
000306          GRID    7040            23.0    10.25   0.0
000307          MAT1    250     24.0E6  9.24E6          7.33E-4
000308          PBAR    7031    250     3.0     10.0    10.0    20.0
000309          $*************************************************************************
000310          $
000311          $       COMPONENT NO. 8      UPPER THRUST STRUCTURE
000312          $
000313          CBAR    8000    8000    8090    8000    8160    0       0       2
000314          CBAR    8001    8000    8001    8040    8110    0       0       2
000315          CBAR    8002    8000    8170    8002    8110    0       0       2
000316          CBAR    8010    8000    8010    8050    8160    0       0       2
000317          CBAR    8021    8000    8021    8100    8140    0       0       2
000318          CBAR    8022    8000    8050    8022    8140    0       0       2
000319          CBAR    8030    8000    8030    8180    8140    0       0       2
000320          CBAR    8040    8000    8040    8020    8140    0       0       2
000321          CBAR    8050    8000    8050    8210    8160    0       0       2
000322          CBAR    8052    8000    8190    8050    8140    0       0       2
000323          CBAR    8061    8170    8060    8080    -10.0   -10.    0.0     1       8061
000324          +8061                   -3.4                    -3.4
000325          CBAR    8065    8190    8060    8080    -10.0   -10.0   0.0     1       8065
000326          +8065                   -2.5                    -2.5
000327          CBAR    8072    8000    8040    8070    8110    0       0       2
000328          CBAR    8073    8170    8070    8060    -10.0   -10.    0.0     1       8073
000329          +8073                   -3.4                    -3.4
000330          CBAR    8075    8190    8070    8060    -10.0   -10.0   0.0     1       8075
000331          +8075                   -2.5                    -2.5
000332          CBAR    8081    8000    8080    8040    8140    0       0       2
000333          CBAR    8085    8190    8080    8090    -10.0   -10.0   -10.0   1       8085
000334          +8085                   -2.5                    -2.5
000335          CBAR    8095    8190    8090    8120    -10.0   -3.75   -14.0   1       8095
000336          +8095                   -2.5                    -2.5
000337          CBAR    8105    8190    8100    8070    -10.0   -10.    10.     1       8105
000338          +8105                   -2.5                    -2.5
000339          CBAR    8125    8190    8120    8170    -10.0   3.75    -14.0   1       8125
000340          +8125                   -2.5                    -2.5
000341          CBAR    8155    8190    8150    8100    -10.0   -3.75   14.0    1       8155
000342          +8155                   -2.5                    -2.5
000343          CBAR    8171    8170    8170    8090    -10.0   0.0     10.0    1       8171
000344          +8171                   -3.4                    -3.4
000345          CBAR    8175    8190    8170    8190    -10.0   10.0    -10.0   1       8175
000346          +8175                   -2.5                    -2.5
000347          CBAR    8181    8170    8180    8100    -10.0   0.0     10.0    1       8181
000348          +8181                   -3.4                    -3.4
000349          CBAR    8185    8190    8180    8150    -10.0   3.75    14.0    1       8185
000350          +8185                   -2.5                    -2.5
000351          CBAR    8191    8170    8190    8200    -10.    10.     0.      1       8191
000352          +8191                   -3.4                    -3.4
000353          CBAR    8195    8190    8190    8200    -10.0   10.0    0.0     1       8195
000354          +8195                   -2.5                    -2.5
000355          CBAR    8201    8170    8200    8210    -10.    10.     0.      1       8201
000356          +8201                   -3.4                    -3.4
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000357  CBAR    8205    8190    8200    8210    -10.0   10.0    0.0     1       8205
000358  +8205                   -2.5                    -2.5
000359  CBAR    8215    8190    8210    8180    -10.0   10.     10.     1       8215
000360  +8215                   -2.5                    -2.5
000361  CODMEM  8006    8006    8040    8110    8130    8001
000362  CODMEM  8011    8006    8050    8160    8130    8010
000363  CODMEM  8043    8006    8040    8110    8140    8020
000364  CODMEM  8192    8006    8050    8160    8140    8022
000365  CROD    8041    8041    8040    8110    8051    8041    8050    8160
000366  CROD    8071    8130    8110    8070    8161    8130    8190    8160
000367  CROD    8111    8130    8110    8140    8140    8130    8140    8180
000368  CROD    8130    8130    8090    8130    8160    8130    8130    8160
000369  CROD    8162    8130    8160    8140    8163    8130    8140    8100
000370  CROD    8171    8130    8170    8130    8131    8130    8130    8110
000371  CROD    8210    8130    8160    8210    8110    8130    8080    8110
000372  CTRIA2  8001    8001    8000    8130    8090
000373  CTRIA2  8002    8002    8005    8130    8000
000374  CTRIA2  8003    8002    8005    8130    8010
000375  CTRIA2  8004    8001    8002    8130    8170
000376  CTRIA2  8005    8002    8005    8130    8002
000377  CTRIA2  8007    8001    8040    8110    8070
000378  CTRIA2  8008    8002    8005    8130    8001
000379  CTRIA2  8012    8012    8000    8001    8005
000380  CTRIA2  8013    8012    8001    8010    8005
000381  CTRIA2  8014    8012    8010    8002    8005
000382  CTRIA2  8015    8012    8002    8000    8005
000383  CTRIA2  8026    8002    8025    8140    8020
000384  CTRIA2  8027    8002    8025    8140    8030
000385  CTRIA2  8031    8001    8030    8140    8180
000386  CTRIA2  8032    8012    8021    8030    8025
000387  CTRIA2  8033    8012    8030    8022    8025
000388  CTRIA2  8034    8012    8022    8020    8025
000389  CTRIA2  8036    8012    8020    8021    8025
000390  CTRIA2  8052    8001    8050    8160    8210
000391  CTRIA2  8082    8001    8040    8110    8080
000392  CTRIA2  8121    8001    8090    8120    8170
000393  CTRIA2  8151    8001    8100    8150    8180
000394  CTRIA2  8191    8001    8050    8160    8190
000395  CTRIA2  8193    8002    8025    8140    8022
000396  CTRIA2  8194    8002    8025    8140    8021
000397  CTRIA2  8195    8001    8021    8140    8100
000398  GRID    8000            17.0    -13.25  3.0
000399  GRID    8001            17.0    -7.25   3.0
000400  GRID    8002            17.0    -13.25  -3.0
000401  GRID    8005            17.0    -10.25  0.0
000402  GRID    8010            17.0    -7.25   -3.0
000403  GRID    8020            17.0    7.25    3.0
000404  GRID    8021            17.0    13.25   3.0
000405  GRID    8022            17.0    7.25    -3.0
000406  GRID    8025            17.0    10.25   0.0
000407  GRID    8030            17.0    13.25   -3.0
000408  GRID    8040            17.0    0.0     10.25
000409  GRID    8050            17.0    0.0     -10.25
000410  GRID    8060            0.0     0.0     24.25
000411  GRID    8070    8000    28.0    60.     0.0
000412  GRID    8080    8000    28.0    120.    0.0
000413  GRID    8090    8000    28.0    150.    0.0
000414  GRID    8100    8000    28.0    30.     0.0
000415  GRID    8110            0.0     0.0     10.25
000416  GRID    8120    8000    28.0    180.    .0
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000417  GRID    8130            0.0     -10.25  .0
000418  GRID    8140            0.0     10.25   .0
000419  GRID    8150    8000    28.0    .0      .0
000420  GRID    8160            0.0     .0      -10.25
000421  GRID    8170    8000    28.0    -150.   .0
000422  GRID    8180    8000    28.0    -30.    .0
000423  GRID    8190    8000    28.0    -120.   .0
000424  GRID    8200            0.0     .0      -24.25
000425  GRID    8210    8000    28.0    -60.    .0
000426  GRID    8300    8000    25.0    215.0   0.0     0       23456
000427  GRID    8400    8000    25.0    125.0   0.0     0       23456
000428  MAT1    2024    10.5E6  4.0E6           2.6E-4
000429  PBAR    8000    2024    1.17    .08     .26
000430  PBAR    8170    2024    0.50    4.3     .0002
000431  PBAR    8190    2024    .8      2.36    2.36    3.55
000432  PODMEM  8006    2024    0.10
000433  PROD    8041    2024    0.35
000434  PROD    8130    2024    0.435
000435  PTRIA2  8001    2024    0.064
000436  PTRIA2  8002    2024    0.20
000437  PTRIA2  8012    2024    .125
000438  $*************************************************************************
000439  $
000440  $                       M I N I - T A N K
000441  $
000442  $                           LOWER (AFT) TRUSS
000443  CROD    85001   8500    8500    8080    85002   8500    8500    8070
000444  CROD    85011   8500    8501    8090    85012   8500    8501    8060
000445  CROD    85021   8500    8502    8060    85022   8500    8502    8100
000446  CROD    85031   8500    8503    8120    85032   8500    8503    8080
000447  CROD    85041   8500    8504    8070    85042   8500    8504    8150
000448  CROD    85051   8500    8505    8170    85052   8500    8505    8090
000449  CROD    85061   8500    8506    8100    85062   8500    8506    8180
000450  CROD    85071   8500    8507    8190    85072   8500    8507    8120
000451  CROD    85081   8500    8508    8150    85082   8500    8508    8210
000452  CROD    85091   8500    8509    8200    85092   8500    8509    8170
000453  CROD    85101   8500    8510    8180    85102   8500    8510    8200
000454  CROD    85111   8500    8511    8210    85112   8500    8511    8190
000455  GRID    8500    8000    68.9330390.     -69.39698000    456
000456  GRID    8501    8000    68.93303120.    -69.39698000    456
000457  GRID    8502    8000    68.9330360.     -69.39698000    456
000458  GRID    8503    8000    68.93303150.    -69.39698000    456
000459  GRID    8504    8000    68.9330330.     -69.39698000    456
000460  GRID    8505    8000    68.93303180.    -69.39698000    456
000461  GRID    8506    8000    68.93303.0      -69.39698000    456
000462  GRID    8507    8000    68.93303-150.   -69.39698000    456
000463  GRID    8508    8000    68.93303-30.    -69.39698000    456
000464  GRID    8509    8000    68.93303-120.   -69.39698000    456
000465  GRID    8510    8000    68.93303-60.    -69.39698000    456
000466  GRID    8511    8000    68.93303-90.    -69.39698000    456
000467  PROD    8500    8500    0.767
000468  $                           UPPER (FORWARD) TRUSS
000469  CROD    86001   8600    8600    8701    86002   8600    8600    8702
000470  CROD    86011   8600    8601    8703    86012   8600    8601    8700
000471  CROD    86021   8600    8602    8700    86022   8600    8602    8704
000472  CROD    86031   8600    8603    8705    86032   8600    8603    8701
000473  CROD    86041   8600    8604    8702    86042   8600    8604    8706
000474  CROD    86051   8600    8605    8707    86052   8600    8605    8703
000475  CROD    86061   8600    8606    8704    86062   8600    8606    8708
000476  CROD    86071   8600    8607    8709    86072   8600    8607    8705
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000477          CROD    86081   8600    8608    8706    86082   8600    8608    8710
000478          CROD    86091   8600    8609    8711    86092   8600    8609    8707
000479          CROD    86101   8600    8610    8708    86102   8600    8610    8711
000480          CROD    86111   8600    8611    8710    86112   8600    8611    8709
000481          GRID    8600    8000    80.0    90.     -219.0  8000    456
000482          GRID    8601    8000    80.0    120.    -219.0  8000    456
000483          GRID    8602    8000    80.0    60.     -219.0  8000    456
000484          GRID    8603    8000    80.     150.    -219.0  8000    456
000485          GRID    8604    8000    80.     30.     -219.0  8000    456
000486          GRID    8605    8000    80.     180.    -219.0  8000    456
000487          GRID    8606    8000    80.     .0      -219.0  8000    456
000488          GRID    8607    8000    80.     -150.   -219.0  8000    456
000489          GRID    8608    8000    80.     -30.    -219.0  8000    456
000490          GRID    8609    8000    80.     -120.   -219.0  8000    456
000491          GRID    8610    8000    80.     -60.    -219.0  8000    456
000492          GRID    8611    8000    80.     -90.    -219.0  8000    456
000493          GRID    8700    8000    85.0    90.     -320.           456
000494          GRID    8701    8000    85.0    120.    -320.           456
000495          GRID    8702    8000    85.0    60.     -320.           456
000496          GRID    8703    8000    85.0    150.    -320.           456
000497          GRID    8704    8000    85.0    30.     -320.           456
000498          GRID    8705    8000    85.0    180.    -320.           456
000499          GRID    8706    8000    85.0    .0      -320.           456
000500          GRID    8707    8000    85.0    -150.   -320.           456
000501          GRID    8708    8000    85.0    -30.    -320.           456
000502          GRID    8709    8000    85.0    -120.   -320.           456
000503          GRID    8710    8000    85.0    -60.    -320.           456
000504          GRID    8711    8000    85.0    -90.    -320.           456
000505          PROD    8600    8500    0.868
000506          MAT1    8500    5.75E6          0.3     1.75E-4
000507          $       ALL CARGO BAY INTERFACE POINTS ARE TO REMAIN IN THE SAME PLANE
000508          MPC     8700    8701    1       1.0     8700    1       -1.0
000509          MPC     8700    8702    1       1.0     8700    1       -1.0
000510          MPC     8700    8703    1       1.0     8700    1       -1.0
000511          MPC     8700    8704    1       1.0     8700    1       -1.0
000512          MPC     8700    8705    1       1.0     8700    1       -1.0
000513          MPC     8700    8706    1       1.0     8700    1       -1.0
000514          MPC     8700    8707    1       1.0     8700    1       -1.0
000515          MPC     8700    8708    1       1.0     8700    1       -1.0
000516          MPC     8700    8709    1       1.0     8700    1       -1.0
000517          MPC     8700    8710    1       1.0     8700    1       -1.0
000518          MPC     8700    8711    1       1.0     8700    1       -1.0
000519          MPC     8700    8701    2       1.0     8700    2       -1.0
000520          MPC     8700    8702    2       1.0     8700    2       -1.0
000521          MPC     8700    8703    2       1.0     8700    2       -1.0
000522          MPC     8700    8704    2       1.0     8700    2       -1.0
000523          MPC     8700    8705    2       1.0     8700    2       -1.0
000524          MPC     8700    8706    2       1.0     8700    2       -1.0
000525          MPC     8700    8707    2       1.0     8700    2       -1.0
000526          MPC     8700    8708    2       1.0     8700    2       -1.0
000527          MPC     8700    8709    2       1.0     8700    2       -1.0
000528          MPC     8700    8710    2       1.0     8700    2       -1.0
000529          MPC     8700    8711    2       1.0     8700    2       -1.0
000530          MPC     8700    8701    3       1.0     8700    3       -1.0
000531          MPC     8700    8702    3       1.0     8700    3       -1.0
000532          MPC     8700    8703    3       1.0     8700    3       -1.0
000533          MPC     8700    8704    3       1.0     8700    3       -1.0
000534          MPC     8700    8705    3       1.0     8700    3       -1.0
000535          MPC     8700    8706    3       1.0     8700    3       -1.0
000536          MPC     8700    8707    3       1.0     8700    3       -1.0
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000537          MPC     8700    8708    3       1.0     8700    3       -1.0
000538          MPC     8700    8709    3       1.0     8700    3       -1.0
000539          MPC     8700    8710    3       1.0     8700    3       -1.0
000540          MPC     8700    8711    3       1.0     8700    3       -1.0
000541          $               MODAL COORDINATE DATA
000542          SPOINT  101     THRU    109
000543          CMASS4  101     2.927   101
000544          CMASS4  102     2.927   102
000545          CMASS4  103     0.664   103
000546          CMASS4  104     1.311   104
000547          CMASS4  105     0.444   105
000548          CMASS4  106     0.2018  106
000549          CMASS4  107     0.1584  107
000550          CMASS4  108     0.1940  108
000551          CMASS4  109     0.2043  109
000552          CELAS4  204     1.251E6 104.
000553          CELAS4  205     1.262E6 105
000554          CELAS4  206     7.457E5 106
000555          CELAS4  207     6.729E5 107
000556          CELAS4  208     8.818E5 108
000557          CELAS4  209     9.914E5 109
000558          $           THESE ARE THE MPC'S FOR THE MODAL CONSTRAINTS
000559          $               MODAL CONSTRAINT EQUATIONS
000560          $*************************************************************************
000561          $
000562          $                       GIMBAL  ACTUATORS
000563          $
000564          CELAS2  8301    1.15E6  6130    1       8300    1
000565          CELAS2  8401    1.15E6  6080    1       8400    1
000566          $*************************************************************************
000567          $
000568          $               T P A   STRUCTURE USED FOR ALL MINI-TANK RUNS
000569          $
000570          $               T P A   # 1
000571          GRID    6061    8000    35.0    -90.    43.             456
000572          CONM2   9007    6061            1.97
000573          CELAS2  60611   2.0E+6  6061    1       6070    1
000574          CELAS2  606121  2.0E+6  6061    2       6070    2
000575          CELAS2  606122  1.4E+6  6061    2       6040    2
000576          CELAS2  606131  2.0E+6  6061    3       6070    3
000577          CELAS2  606132  1.4E+6  6061    3       6040    3
000578          $
000579          $               T P A   # 2
000580          GRID    6062    8000    35.0     90.    43.             456
000581          CONM2   9008    6062            1.97
000582          CELAS2  60621   2.0E+6  6062    1       6070    1
000583          CELAS2  606221  2.0E+6  6062    2       6070    2
000584          CELAS2  606222  1.4E+6  6062    2       6040    2
000585          CELAS2  606231  2.0E+6  6062    3       6070    3
000586          CELAS2  606232  1.4E+6  6062    3       6040    3
000587          $*************************************************************************
000588          $
000589          $                       EOS SUPPORT FRAME
000590          $                        SUPPORT FRAME DELETED
000591          $
000592          $*************************************************************************
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APPENDIX B

MULTI-POINT CONSTRAINT EQUATIONS

@ ELT RUNTNK/MPCS,1,720110, 45151

000001	MPC	8500	8500	1	1.0000	101	0 .0000	85001A
000002	MPC	8500	8500	2	1.0000	101	0 .0000	85002A
000003	MPC	8500	8500	3	1.0000	101	0 -1.0000	85003A
000004	MPC	8500	8501	1	1.0000	101	0 .0000	85011A
000005	MPC	8500	8501	2	1.0000	101	0 .0000	85012A
000006	MPC	8500	8501	3	1.0000	101	0 -1.0000	85013A
000007	MPC	8500	8502	1	1.0000	101	0 .0000	85021A
000008	MPC	8500	8502	2	1.0000	101	0 .0000	85022A
000009	MPC	8500	8502	3	1.0000	101	0 -1.0000	85023A
000010	MPC	8500	8503	1	1.0000	101	0 .0000	85031A
000011	MPC	8500	8503	2	1.0000	101	0 .0000	85032A
000012	MPC	8500	8503	3	1.0000	101	0 -1.0000	85033A
000013	MPC	8500	8504	1	1.0000	101	0 .0000	85041A
000014	MPC	8500	8504	2	1.0000	101	0 .0000	85042A
000015	MPC	8500	8504	3	1.0000	101	0 -1.0000	85043A
000016	MPC	8500	8505	1	1.0000	101	0 .0000	85051A
000017	MPC	8500	8505	2	1.0000	101	0 .0000	85052A
000018	MPC	8500	8505	3	1.0000	101	0 -1.0000	85053A
000019	MPC	8500	8506	1	1.0000	101	0 .0000	85061A
000020	MPC	8500	8506	2	1.0000	101	0 .0000	85062A
000021	MPC	8500	8506	3	1.0000	101	0 -1.0000	85063A
000022	MPC	8500	8507	1	1.0000	101	0 .0000	85071A
000023	MPC	8500	8507	2	1.0000	101	0 .0000	85072A
000024	MPC	8500	8507	3	1.0000	101	0 -1.0000	85073A
000025	MPC	8500	8508	1	1.0000	101	0 .0000	85081A
000026	MPC	8500	8508	2	1.0000	101	0 .0000	85082A
000027	MPC	8500	8508	3	1.0000	101	0 -1.0000	85083A
000028	MPC	8500	8509	1	1.0000	101	0 .0000	85091A
000029	MPC	8500	8509	2	1.0000	101	0 .0000	85092A
000030	MPC	8500	8509	3	1.0000	101	0 -1.0000	85093A
000031	MPC	8500	8510	1	1.0000	101	0 .0000	85101A
000032	MPC	8500	8510	2	1.0000	101	0 .0000	85102A
000033	MPC	8500	8510	3	1.0000	101	0 -1.0000	85103A
000034	MPC	8500	8511	1	1.0000	101	0 .0000	85111A
000035	MPC	8500	8511	2	1.0000	101	0 .0000	85112A
000036	MPC	8500	8511	3	1.0000	101	0 -1.0000	85113A
000037	MPC	8500	8600	1	1.0000	101	0 .0000	86001A
000038	MPC	8500	8600	2	1.0000	101	0 .0000	86002A
000039	MPC	8500	8600	3	1.0000	101	0 -1.0000	86003A
000040	MPC	8500	8601	1	1.0000	101	0 .0000	86011A
000041	MPC	8500	8601	2	1.0000	101	0 .0000	86012A
000042	MPC	8500	8601	3	1.0000	101	0 -1.0000	86013A
000043	MPC	8500	8602	1	1.0000	101	0 .0000	86021A
000044	MPC	8500	8602	2	1.0000	101	0 .0000	86022A
000045	MPC	8500	8602	3	1.0000	101	0 -1.0000	86023A
000046	MPC	8500	8603	1	1.0000	101	0 .0000	86031A
000047	MPC	8500	8603	2	1.0000	101	0 .0000	86032A
000048	MPC	8500	8603	3	1.0000	101	0 -1.0000	86033A
000049	MPC	8500	8604	1	1.0000	101	0 .0000	86041A
000050	MPC	8500	8604	2	1.0000	101	0 .0000	86042A
000051	MPC	8500	8604	3	1.0000	101	0 -1.0000	86043A
000052	MPC	8500	8605	1	1.0000	101	0 .0000	86051A
000053	MPC	8500	8605	2	1.0000	101	0 .0000	86052A
000054	MPC	8500	8605	3	1.0000	101	0 -1.0000	86053A
000055	MPC	8500	8606	1	1.0000	101	0 .0000	86061A
000056	MPC	8500	8606	2	1.0000	101	0 .0000	86062A

000057	MPC	8500	8606	3	1.0000	101	0	-1.0000	86063A
000058	MPC	8500	8607	1	1.0000	101	0	.0000	86071A
000059	MPC	8500	8607	2	1.0000	101	0	.0000	86072A
000060	MPC	8500	8607	3	1.0000	101	0	-1.0000	86073A
000061	MPC	8500	8608	1	1.0000	101	0	.0000	86081A
000062	MPC	8500	8608	2	1.0000	101	0	.0000	86082A
000063	MPC	8500	8608	3	1.0000	101	0	-1.0000	86083A
000064	MPC	8500	8609	1	1.0000	101	0	.0000	86091A
000065	MPC	8500	8609	2	1.0000	101	0	.0000	86092A
000066	MPC	8500	8609	3	1.0000	101	0	-1.0000	86093A
000067	MPC	8500	8610	1	1.0000	101	0	.0000	86101A
000068	MPC	8500	8610	2	1.0000	101	0	.0000	86102A
000069	MPC	8500	8610	3	1.0000	101	0	-1.0000	86103A
000070	MPC	8500	8611	1	1.0000	101	0	.0000	86111A
000071	MPC	8500	8611	2	1.0000	101	0	.0000	86112A
000072	MPC	8500	8611	3	1.0000	101	0	-1.0000	86113A
000073	+85001A		102	0	.0000	103	0	.0000	85001B
000074	+85002A		102	0	1.0000	103	0	.7257	85002B
000075	+85003A		102	0	.0000	103	0	.0000	85003B
000076	+85011A		102	0	.5000	103	0	.3806	85011B
000077	+85012A		102	0	.8660	103	0	.6285	85012B
000078	+85013A		102	0	.0000	103	0	.1691	85013B
000079	+85021A		102	0	-.5000	103	0	-.3806	85021B
000080	+85022A		102	0	.8660	103	0	.6285	85022B
000081	+85023A		102	0	.0000	103	0	-.1691	85023B
000082	+85031A		102	0	.8660	103	0	.6592	85031B
000083	+85032A		102	0	.5000	103	0	.3629	85032B
000084	+85033A		102	0	.0000	103	0	.2929	85033B
000085	+85041A		102	0	-.8660	103	0	-.6592	85041B
000086	+85042A		102	0	.5000	103	0	.3629	85042B
000087	+85043A		102	0	.0000	103	0	-.2929	85043B
000088	+85051A		102	0	1.0000	103	0	.7612	85051B
000089	+85052A		102	0	.0000	103	0	.0000	85052B
000090	+85053A		102	0	.0000	103	0	.3382	85053B
000091	+85061A		102	0	-1.0000	103	0	-.7612	85061B
000092	+85062A		102	0	.0000	103	0	.0000	85062B
000093	+85063A		102	0	.0000	103	0	-.3382	85063B
000094	+85071A		102	0	.8660	103	0	.6592	85071B
000095	+85072A		102	0	-.5000	103	0	-.3629	85072B
000096	+85073A		102	0	.0000	103	0	.2929	85073B
000097	+85081A		102	0	-.8660	103	0	-.6592	85081B
000098	+85082A		102	0	-.5000	103	0	-.3629	85082B
000099	+85083A		102	0	.0000	103	0	-.2929	85083B
000100	+85091A		102	0	.5000	103	0	.3806	85091B
000101	+85092A		102	0	-.8660	103	0	-.6285	85092B
000102	+85093A		102	0	.0000	103	0	.1691	85093B
000103	+85101A		102	0	-.5000	103	0	-.3806	85101B
000104	+85102A		102	0	-.8660	103	0	-.6285	85102B
000105	+85103A		102	0	.0000	103	0	-.1691	85103B
000106	+85111A		102	0	.0000	103	0	.0000	85111B
000107	+85112A		102	0	-1.0000	103	0	-.7257	85112B
000108	+85113A		102	0	.0000	103	0	.0000	85113B
000109	+86001A		102	0	.0000	103	0	.0000	86001B
000110	+86002A		102	0	1.0000	103	0	-.1132	86002B
000111	+86003A		102	0	.0000	103	0	.0000	86003B
000112	+86011A		102	0	.5000	103	0	-.0739	86011B
000113	+86012A		102	0	.8660	103	0	-.0981	86012B
000114	+86013A		102	0	.0000	103	0	.2403	86013B
000115	+86021A		102	0	-.5000	103	0	.0739	86021B
000116	+86022A		102	0	.0660	103	0	-.0981	86022B

000117	+86023A	102	0	.0000	103	0	-.2403	86023B
000118	+86031A	102	0	.8660	103	0	-.1279	86031B
000119	+86032A	102	0	.5000	103	0	-.0566	86032B
000120	+86033A	102	0	.0000	103	0	.4163	86033B
000121	+86041A	102	0	-.8660	103	0	.1279	86041B
000122	+86042A	102	0	.5000	103	0	-.0566	86042B
000123	+86043A	102	0	.0000	103	0	-.4163	86043B
000124	+86051A	102	0	1.0000	103	0	-.1477	86051B
000125	+86052A	102	0	.0000	103	0	.0000	86052B
000126	+86053A	102	0	.0000	103	0	.4807	86053B
000127	+86061A	102	0	-1.0000	103	0	.1477	86061B
000128	+86062A	102	0	.0000	103	0	.0000	86062B
000129	+86063A	102	0	.0000	103	0	-.4807	86063B
000130	+86071A	102	0	.8660	103	0	-.1279	86071B
000131	+86072A	102	0	-.5000	103	0	.0566	86072B
000132	+86073A	102	0	.0000	103	0	.4163	86073B
000133	+86081A	102	0	-.8660	103	0	.1279	86081B
000134	+86082A	102	0	-.5000	103	0	.0566	86082B
000135	+86083A	102	0	.0000	103	0	-.4163	86083B
000136	+86091A	102	0	.5000	103	0	-.0739	86091B
000137	+86092A	102	0	-.8660	103	0	.0981	86092B
000138	+86093A	102	0	.0000	103	0	.2403	86093B
000139	+86101A	102	0	-.5000	103	0	.0739	86101B
000140	+86102A	102	0	-.8660	103	0	.0981	86102B
000141	+86103A	102	0	.0000	103	0	-.2403	86103B
000142	+86111A	102	0	.0000	103	0	.0000	86111B
000143	+86112A	102	0	-1.0000	103	0	.1132	86112B
000144	+86113A	102	0	.0000	103	0	.0000	86113B
000145	+85001B	104	0	.0000	105	0	.0000	85001C
000146	+85002B	104	0	.8624	105	0	.0496	85002C
000147	+85003B	104	0	.0000	105	0	.0000	85003C
000148	+85011B	104	0	.4771	105	0	.0695	85011C
000149	+85012B	104	0	.7468	105	0	.0430	85012C
000150	+85013B	104	0	-.0564	105	0	.3531	85013C
000151	+85021B	104	0	-.4771	105	0	-.0695	85021C
000152	+85022B	104	0	.7468	105	0	.0430	85022C
000153	+85023B	104	0	.0564	105	0	-.3531	85023C
000154	+85031B	104	0	.8264	105	0	.1203	85031C
000155	+85032B	104	0	.4312	105	0	.0248	85032C
000156	+85033B	104	0	-.0976	105	0	.6116	85033C
000157	+85041B	104	0	-.8264	105	0	-.1203	85041C
000158	+85042B	104	0	.4312	105	0	.0248	85042C
000159	+85043B	104	0	.0976	105	0	-.6116	85043C
000160	+85051B	104	0	.9543	105	0	.1389	85051C
000161	+85052B	104	0	.0000	105	0	.0000	85052C
000162	+85053B	104	0	-.1127	105	0	.7062	85053C
000163	+85061B	104	0	-.9543	105	0	-.1389	85061C
000164	+85062B	104	0	.0000	105	0	.0000	85062C
000165	+85063B	104	0	.1127	105	0	-.7062	85063C
000166	+85071B	104	0	.8264	105	0	.1203	85071C
000167	+85072B	104	0	-.4312	105	0	-.0248	85072C
000168	+85073B	104	0	-.0976	105	0	.6116	85073C
000169	+85081B	104	0	-.8264	105	0	-.1203	85081C
000170	+85082B	104	0	-.4312	105	0	-.0248	85082C
000171	+85083B	104	0	.0976	105	0	-.6116	85083C
000172	+85091B	104	0	.4771	105	0	.0695	85091C
000173	+85092B	104	0	-.7468	105	0	-.0430	85092C
000174	+85093B	104	0	-.0564	105	0	.3531	85093C
000175	+85101B	104	0	-.4771	105	0	-.0695	85101C
000176	+85102B	104	0	-.7468	105	0	-.0430	85102C

000177	+85103B	104	0	.0564	105	0	-.3531	85103C
000178	+85111B	104	0	.0000	105	0	.0000	85111C
000179	+85112B	104	0	-.8624	105	0	-.0496	85112C
000180	+85113B	104	0	.0000	105	0	.0000	85113C
000181	+86001B	104	0	.0000	105	0	.0000	86001C
000182	+86002B	104	0	-.3543	105	0	.0277	86002C
000183	+86003B	104	0	.0000	105	0	.0000	86003C
000184	+86011B	104	0	-.1574	105	0	.0287	86011C
000185	+86012B	104	0	-.3068	105	0	.0240	86012C
000186	+86013B	104	0	-.4107	105	0	-.0013	86013C
000187	+86021B	104	0	.1574	105	0	-.0287	86021C
000188	+86022B	104	0	-.3068	105	0	.0240	86022C
000189	+86023B	104	0	.4107	105	0	.0013	86023C
000190	+86031B	104	0	-.2727	105	0	.0498	86031C
000191	+86032B	104	0	-.1771	105	0	.0138	86032C
000192	+86033B	104	0	-.7113	105	0	-.0022	86033C
000193	+86041B	104	0	.2727	105	0	-.0498	86041C
000194	+86042B	104	0	-.1771	105	0	.0138	86042C
000195	+86043B	104	0	.7113	105	0	.0022	86043C
000196	+86051B	104	0	-.3149	105	0	.0575	86051C
000197	+86052B	104	0	.0000	105	0	.0000	86052C
000198	+86053B	104	0	-.8213	105	0	-.0025	86053C
000199	+86061B	104	0	.3149	105	0	-.0575	86061C
000200	+86062B	104	0	.0000	105	0	.0000	86062C
000201	+86063B	104	0	.8213	105	0	.0025	86063C
000202	+86071B	104	0	-.2727	105	0	.0498	86071C
000203	+86072B	104	0	.1771	105	0	-.0138	86072C
000204	+86073B	104	0	-.7113	105	0	-.0022	86073C
000205	+86081B	104	0	.2727	105	0	-.0498	86081C
000206	+86082B	104	0	.1771	105	0	-.0138	86082C
000207	+86083B	104	0	.7113	105	0	.0022	86083C
000208	+86091B	104	0	-.1574	105	0	.0287	86091C
000209	+86092B	104	0	.3068	105	0	-.0240	86092C
000210	+86093B	104	0	-.4107	105	0	-.0013	86093C
000211	+86101B	104	0	.1574	105	0	-.0287	86101C
000212	+86102B	104	0	.3068	105	0	-.0240	86102C
000213	+86103B	104	0	.4107	105	0	.0013	86103C
000214	+86111B	104	0	.0000	105	0	.0000	86111C
000215	+86112B	104	0	.3543	105	0	-.0277	86112C
000216	+86113B	104	0	.0000	105	0	.0000	86113C
000217	+85001C	106	0	.0000	107	0	.0000	85001D
000218	+85002C	106	0	-.0379	107	0	-.0013	85002D
000219	+85003C	106	0	.0000	107	0	.0000	85003D
000220	+85011C	106	0	-.0401	107	0	.0790	85011D
000221	+85012C	106	0	-.0328	107	0	-.0011	85012D
000222	+85013C	106	0	-.0436	107	0	-.0516	85013D
000223	+85021C	106	0	.0401	107	0	-.0790	85021D
000224	+85022C	106	0	-.0328	107	0	-.0011	85022D
000225	+85023C	106	0	.0436	107	0	.0516	85023D
000226	+85031C	106	0	-.0694	107	0	.1369	85031D
000227	+85032C	106	0	-.0190	107	0	-.0006	85032D
000228	+85033C	106	0	-.0755	107	0	-.0893	85033D
000229	+85041C	106	0	.0694	107	0	-.1369	85041D
000230	+85042C	106	0	-.0190	107	0	-.0006	85042D
000231	+85043C	106	0	.0755	107	0	.0893	85043D
000232	+85051C	106	0	-.0801	107	0	.1581	85051D
000233	+85052C	106	0	.0000	107	0	.0000	85052D
000234	+85053C	106	0	-.0871	107	0	-.1031	85053D
000235	+85061C	106	0	.0801	107	0	-.1581	85061D
000236	+85062C	106	0	.0000	107	0	.0000	85062D

000237	+85063C	106	0	.0871	107	0	.1031	85063D
000238	+85071C	106	0	-.0694	107	0	.1369	85071D
000239	+85072C	106	0	.0190	107	0	.0006	85072D
000240	+85073C	106	0	-.0755	107	0	-.0893	85073D
000241	+85081C	106	0	.0694	107	0	-.1369	85081D
000242	+85082C	106	0	.0190	107	0	.0006	85082D
000243	+85083C	106	0	.0755	107	0	.0893	85083D
000244	+85091C	106	0	-.0401	107	0	.0790	85091D
000245	+85092C	106	0	.0328	107	0	.0011	85092D
000246	+85093C	106	0	-.0436	107	0	-.0516	85093D
000247	+85101C	106	0	.0401	107	0	-.0790	85101D
000248	+85102C	106	0	.0328	107	0	.0011	85102D
000249	+85103C	106	0	.0436	107	0	.0516	85103D
000250	+85111C	106	0	.0000	107	0	.0000	85111D
000251	+85112C	106	0	.0379	107	0	.0013	85112D
000252	+85113C	106	0	.0000	107	0	.0000	85113D
000253	+86001C	106	0	.0000	107	0	.0000	86001D
000254	+86002C	106	0	-.0739	107	0	-.0003	86002D
000255	+86003C	106	0	.0000	107	0	.0000	86003D
000256	+86011C	106	0	-.0673	107	0	-.0039	86011D
000257	+86012C	106	0	-.0640	107	0	-.0002	86012D
000258	+86013C	106	0	.0597	107	0	.0005	86013D
000259	+86021C	106	0	.0673	107	0	.0039	86021D
000260	+86022C	106	0	-.0640	107	0	-.0002	86022D
000261	+86023C	106	0	-.0597	107	0	-.0005	86023D
000262	+86031C	106	0	-.1166	107	0	-.0067	86031D
000263	+86032C	106	0	-.0369	107	0	-.0001	86032D
000264	+86033C	106	0	.1034	107	0	.0008	86033D
000265	+86041C	106	0	.1166	107	0	.0067	86041D
000266	+86042C	106	0	-.0369	107	0	-.0001	86042D
000267	+86043C	106	0	-.1034	107	0	-.0008	86043D
000268	+86051C	106	0	-.1347	107	0	-.0077	86051D
000269	+86052C	106	0	.0000	107	0	.0000	86052D
000270	+86053C	106	0	.1194	107	0	.0010	86053D
000271	+86061C	106	0	.1347	107	0	.0077	86061D
000272	+86062C	106	0	.0000	107	0	.0000	86062D
000273	+86063C	106	0	-.1194	107	0	-.0010	86063D
000274	+86071C	106	0	-.1166	107	0	-.0067	86071D
000275	+86072C	106	0	.0369	107	0	.0001	86072D
000276	+86073C	106	0	.1034	107	0	.0008	86073D
000277	+86081C	106	0	.1166	107	0	.0067	86081D
000278	+86082C	106	0	.0369	107	0	.0001	86082D
000279	+86083C	106	0	-.1034	107	0	-.0008	86083D
000280	+86091C	106	0	-.0673	107	0	-.0039	86091D
000281	+86092C	106	0	.0640	107	0	.0002	86092D
000282	+86093C	106	0	.0597	107	0	.0005	86093D
000283	+86101C	106	0	.0673	107	0	.0039	86101D
000284	+86102C	106	0	.0640	107	0	.0002	86102D
000285	+86103C	106	0	-.0597	107	0	-.0005	86103D
000286	+86111C	106	0	.0000	107	0	.0000	86111D
000287	+86112C	106	0	.0739	107	0	.0003	86112D
000288	+86113C	106	0	.0000	107	0	.0000	86113D
000289	+85001D	108	0	.0000	109	0	.0000	
000290	+85002D	108	0	.0249	109	0	-.0395	
000291	+85003D	108	0	.0000	109	0	.0000	
000292	+85011D	108	0	-.3739	109	0	.2263	
000293	+85012D	108	0	.0216	109	0	-.0342	
000294	+85013D	108	0	.2015	109	0	-.0979	
000295	+85021D	108	0	.3739	109	0	-.2263	
000296	+85022D	108	0	.0216	109	0	-.0342	

000297	+85023D	108	0	-.2015	109	0	.0979
000298	+85031D	108	0	-.6475	109	0	.3920
000299	+85032D	108	0	.0125	109	0	-.0198
000300	+85033D	108	0	.3490	109	0	-.1695
000301	+85041D	108	0	.6475	109	0	-.3920
000302	+85042D	108	0	.0125	109	0	-.0198
000303	+85043D	108	0	-.3490	109	0	.1695
000304	+85051D	108	0	-.7477	109	0	.4527
000305	+85052D	108	0	.0000	109	0	.0000
000306	+85053D	108	0	.4030	109	0	-.1958
000307	+85061D	108	0	.7477	109	0	-.4527
000308	+85062D	108	0	.0000	109	0	.0000
000309	+85063D	108	0	-.4030	109	0	.1958
000310	+85071D	108	0	-.6475	109	0	.3920
000311	+85072D	108	0	-.0125	109	0	.0198
000312	+85073D	108	0	.3490	109	0	-.1695
000313	+85081D	108	0	.6475	109	0	-.3920
000314	+85082D	108	0	-.0125	109	0	.0198
000315	+85083D	108	0	-.3490	109	0	.1695
000316	+85091D	108	0	-.3739	109	0	.2263
000317	+85092D	108	0	-.0216	109	0	.0342
000318	+85093D	108	0	.2015	109	0	-.0979
000319	+85101D	108	0	.3739	109	0	-.2263
000320	+85102D	108	0	-.0216	109	0	.0342
000321	+85103D	108	0	-.2015	109	0	.0979
000322	+85111D	108	0	.0000	109	0	.0000
000323	+85112D	108	0	-.0249	109	0	.0395
000324	+85113D	108	0	.0000	109	0	.0000
000325	+86001D	108	0	.0000	109	0	.0000
000326	+86002D	108	0	.0032	109	0	-.0056
000327	+86003D	108	0	.0000	109	0	.0000
000328	+86011D	108	0	-.0012	109	0	-.0121
000329	+86012D	108	0	.0028	109	0	-.0048
000330	+86013D	108	0	.0030	109	0	-.0094
000331	+86021D	108	0	.0012	109	0	.0121
000332	+86022D	108	0	.0028	109	0	-.0048
000333	+86023D	108	0	-.0030	109	0	.0094
000334	+86031D	108	0	-.0021	109	0	-.0209
000335	+86032D	108	0	.0016	109	0	-.0028
000336	+86033D	108	0	.0051	109	0	-.0162
000337	+86041D	108	0	.0021	109	0	.0209
000338	+86042D	108	0	.0016	109	0	-.0028
000339	+86043D	108	0	-.0051	109	0	.0162
000340	+86051D	108	0	-.0024	109	0	-.0242
000341	+86052D	108	0	.0000	109	0	.0000
000342	+86053D	108	0	.0059	109	0	-.0188
000343	+86061D	108	0	.0024	109	0	.0242
000344	+86062D	108	0	.0000	109	0	.0000
000345	+86063D	108	0	-.0059	109	0	.0188
000346	+86071D	108	0	-.0021	109	0	-.0209
000347	+86072D	108	0	-.0016	109	0	.0028
000348	+86073D	108	0	.0051	109	0	-.0162
000349	+86081D	108	0	.0021	109	0	.0209
000350	+86082D	108	0	-.0016	109	0	.0028
000351	+86083D	108	0	-.0051	109	0	.0162
000352	+86091D	108	0	-.0012	109	0	-.0121
000353	+86092D	108	0	-.0028	109	0	.0048
000354	+86093D	108	0	.0030	109	0	-.0094
000355	+86101D	108	0	.0012	109	0	.0121
000356	+86102D	108	0	-.0028	109	0	.0048

000357	+86103D	108	0	-.0030	109	0	.0094
000358	+86111D	108	0	.0000	109	0	.0000
000359	+86112D	108	0	-.0032	109	0	.0056
000360	+86113D	108	0	.0000	109	0	.0000